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Increasing uses to see the invisible

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Dangers of the Laser miracle ray

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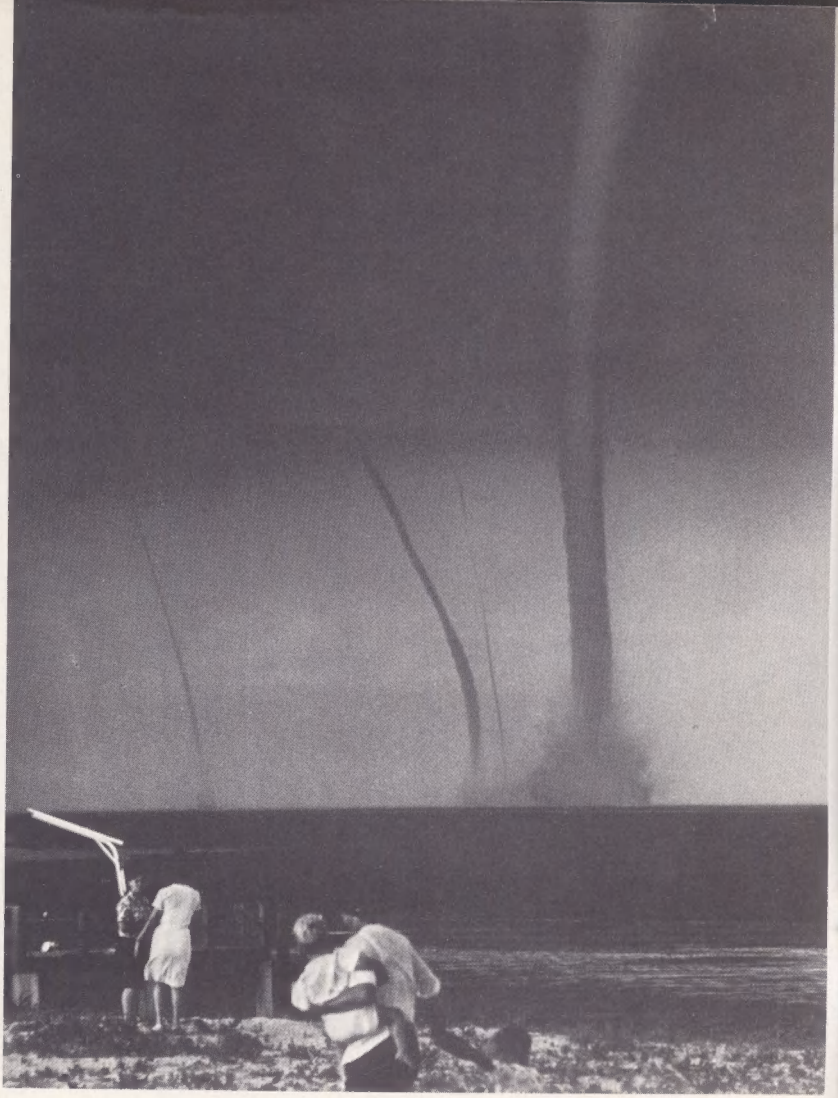

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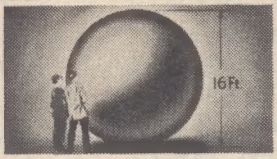

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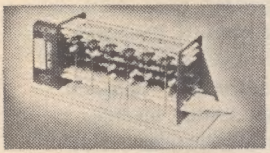

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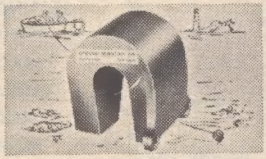

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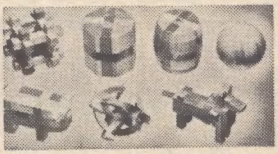

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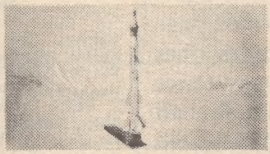

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THIS MONTH

The fact is, we are as much interested in the UFO mystery as anyone. And any time we see sound scientific evidence explaining UFO phenomena (whether it explains away "flying saucers", or pins them down as something solid and real), you can be sure we'll alert you.

Hal Heller's article on ball lightning and corona phenomena on page 9 is a dandy example. It describes one of the most curious mysteries known. I can vouch for one fireball the size of a basketball that floated out of my fireplace after a lightning bolt hit nearby. The thing bounded across the room without touching the floor—hit the far wall and vanished with a *snap*.

Whether it makes you mad or not, we know you'll be interested in Mr. Heller's article on a genuine science enigma.—RFD

news, knowledge, advice

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DIGEST

In order to find out what it will be like to walk on the moon NASA scientists must repeal the law of gravity here on earth. It's not easy. In order to simulate moonwalking engineers and astronauts have been scampering up walls like a bunch of human flies. Story begins on page 6.

NASA photo; Langley Research Center

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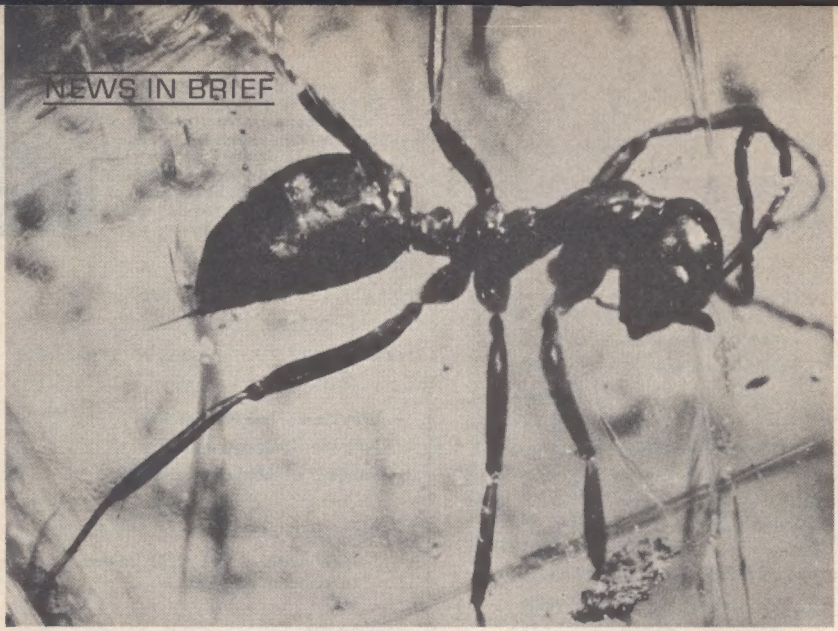


Bulletins at press time

OLDEST ANTS. A lump of amber found in New Jersey contains the world's oldest ants (above). They have been described as "a real missing link" in the evolution of insects. The ants are 100 million years old, 40 million years older than any previously known. They were found in Cliffwood, N.J.

THE HEAVIEST ATOM. Scientists at the University of California's Lawrence Radiation Lab have created the isotope mendelevium 258, the heaviest atom yet found. Surprisingly, this isotope does not decay almost instantly, as do most of the artifically created heavy elements. Half life is two months.

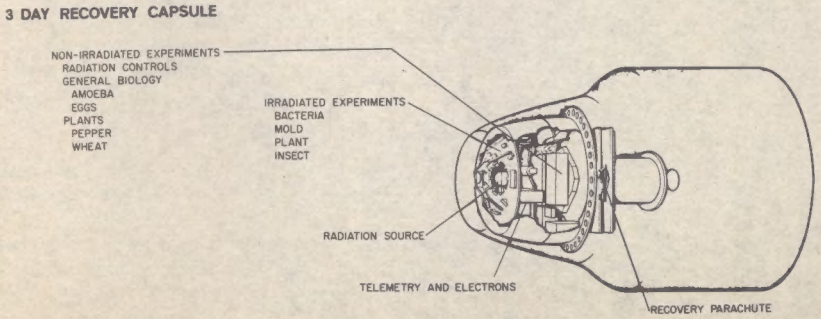
UFO'S CONTRARY TO LAWS OF PHYSICS. "The control of reported UFO's by extraterrestrial beings is contrary to the laws of physics," according to Dr. William Markowitz, professor of physics at Marquette University, Milwaukee. Dr. Markowitz who has reviewed the "scientific evidence" gathered on UFO's concluded that "the data published do not justify the holding of investigations." He agreed that "unidentified objects exist" but he contended that it was absurd to believe they, "were under extraterrestrial control."

PIRANHA IS A COWARD. A group of international scientists studying life in the Amazon Basin have made some striking discoveries, among them: the feared piranha is really a cowardly fish, preferring crippled prey his own size or smaller; the electric fish has a sixth sense--the ability to "see" with the aid of its own electricity; the boa constrictor uses sensitive heat receptors in his lips to detect prey and the fresh water dolphin has a completely different "voice" than the sea going dolphin.

TREASURE IN THE RED SEA. What may be the richest concentration of underwater ores ever found has been discovered on the bottom of the Red Sea. Scientists from Woods Hole Oceanographic Institution who made the discovery estimate that the value of the gold, silver, zinc and copper in one area alone may be at least $1.5 billion.

MORE AUTOPSIES. A New York physician has told his colleagues that not enough autopsies are performed and as a result U.S. mortality statistics are warped. Dr. John Prutting said that studies have shown a wide variation between autopsy findings and diagnosis made before death.

THE LOWLY IN ORBIT. A whole satellite full of lowly creatures from flour beetles to bread mould spores were orbited in Biosatellite (below) to test the effects of weightlessness on living organisms. Preliminary results indicate that effects of the test may be "astounding."



AEROSPACE

How to walk on the moon

by James R. Berry

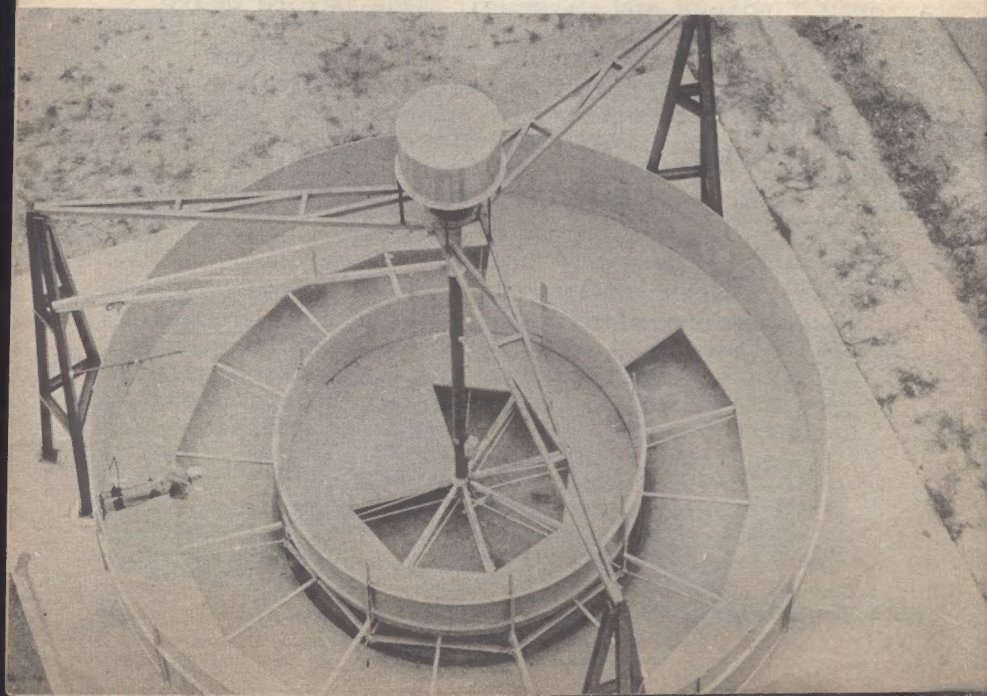
TWO YEARS AGO, astronaut Richard Gordon—exhausted and with sweat running off his face—cut short his walk in space and wearily regained his Gemini spacecraft. The strain of his working in no-gravity conditions perplexed space officials and underscored a vexing question.

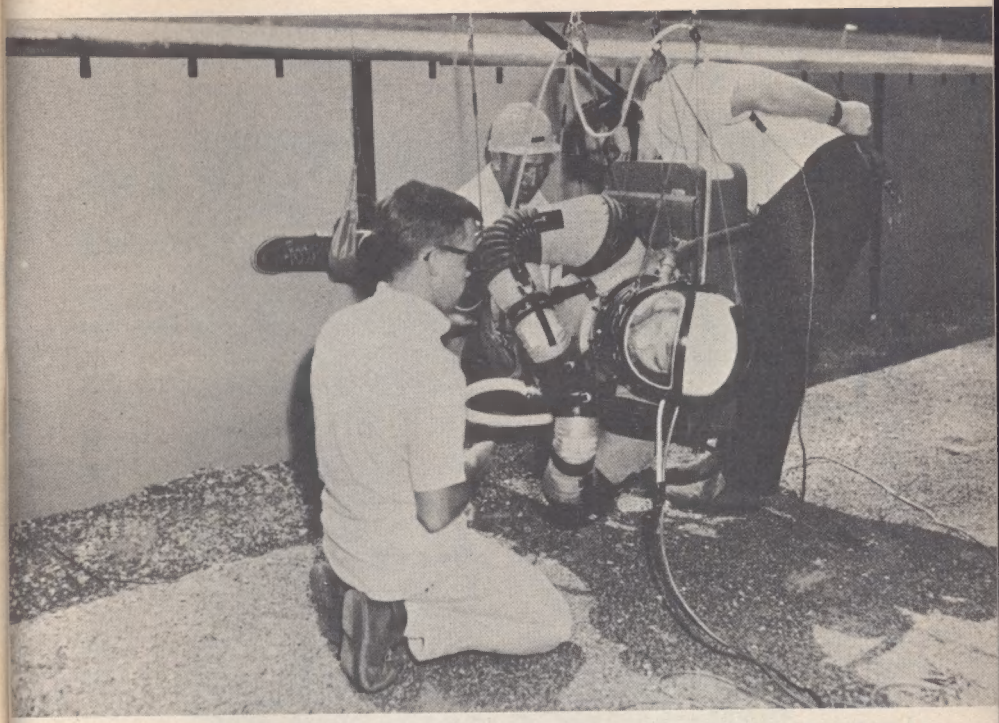
How will astronauts work in the low gravity of the moon where they'll have to explore terrain, build bases and make repairs on equipment and homebound rockets?

At the National Aeronautics and Space Administration's Langley Research Center in Virginia, researchers are finding out. Gravity can't be eliminated entirely on or near Earth, except for tantalizingly short parabolic flights in airplanes, but a recently developed gravity simulator has enabled NASA scientists to reduce gravity to moon level.

The gravity simulator resembles a tilted fence. The researcher stands on the fence horizontally, held up by slings around his legs, arms, torso and head. The slings are attached to 40-foot cables strung from an overhead cart. As the man walks along the tilted fence, the cart follows on a track. The walkway's tilt and the height of the cables are so

Reprinted with permission from Popular Mechanics





The closest thing to walking on the moon is walking on the wall of the National Aeronautics and Space Administration's gravity simulator at Langley Research Center in Virginia. In the simulator moon-suit maneuverability can be tested as above.

Seen from above is model of the gravity simulator (left). The test subject is held up by slings attached to 40-foot cables strung from an overhead cart. The arrangement gives the subject the feeling of weight he could expect at one-sixth earth gravity.

Dead run "on the moon" (right) is accomplished in simulator. Keeping balance under these conditions is difficult because feet don't press down hard enough to give subject a clue to position. Subjects tend to rock back and forth to sense position.

adjusted that a man presses against the walkway with just one-sixth his normal weight. Moon gravity!

The gravity simulator has given NASA scientists their first good picture of what moon work will be like. Predictably, men will be able to make 14-foot, slow-motion leaps. They'll do backflips and other gymnastics like professionals, and easily scamper up ladders and poles with their arms. But the moon's low gravity will cause problems, too.

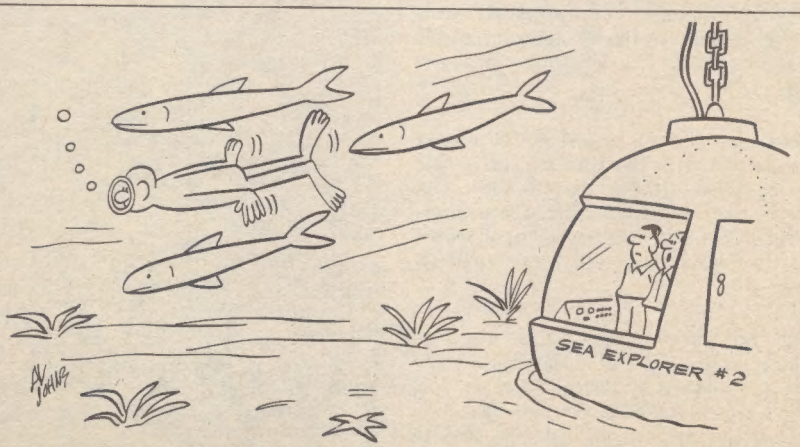
Keeping balance is a big one. An astronaut's feet won't press down hard enough to give clear clues to their position. Subjects using the gravity simulator unconsciously bend forward, one foot ahead of the other, and rock back and forth trying to sense the position of their feet. Many subjects ended up on their tip toes, where all weight was concentrated on a smaller area. Preserving balance during long leaps is even more difficult. After a jump, astronauts will tend to tumble sideways as they drift down.

One consolation: Even a bad moon fall will be so gentle it won't hurt.

Another problem, however, is lack of traction. Walking on the moon will be like traveling on ice. One sudden move will send an astronaut sprawling.

Engineers are busily working to solve these and other problems that will confront moon explorers. Shoes will have high-traction soles that dig into the moon's surface. Stairs will sport higher steps and wider treads for easier mounting. In shirtsleeve bases, stairs might be scrapped and poles substituted instead. And ceilings will be 10 to 12 feet high so a fast or sudden step won't result in a cracked head.

The solutions to some of these problems are being sought in the moon simulator where men on Earth are getting their first experience of what it will be like to walk on the moon.



"I'm getting worried about the professor!"

U.P.I.

A new look at the UFO enigma

One solution to the flying saucer problem may be at hand. This answer does not lie in outer space but in neon signs and that strange phenomenon called ball lightning.

by Hal Hellman

A number of respected scientists have recently begun to take notice of UFOs. But their reasons for doing so will give little comfort to those who believe in spaceships. At long last, a natural phenomenon which provides a satisfactory explanation for the existence of flying saucers has been proposed. Convincing evidence has been produced that some UFOs are examples of glowing plasma, not very different from St. Elmo's fire, aurora, airglow, lightning, neon signs—and especially, ball lightning.

Until recently, ball lightning itself was suspect. After all, how would you react on hearing that during a thunderstorm someone's fireplace screen fell over as if blown by a wind, after which a yellowish, glowing ball entered the room through the fireplace opening? Although luminous, it didn't appear to be hot. After floating about in the room for a while it went back up the chimney and apparently exploded as it reached the top, for a shower of stones was thrown down from the chimney.

The scientist in you would probably want to see the stones and the damage to the chimney. Upon being satisfied on that score, you would probably figure that the damage came from a lightning strike and that the observer was the victim of hallucination.

Another possibility is that the ball seen by the observer was an optical illusion. This could arise from saturation of the retina in the eye due to a nearby lightning stroke or even a bright light. The image is carried along as the observer shifts his eyes.

But all stories about ball lightning are not so easily explained. The very possibility that glowing balls of "lightning" could exist for extended periods—said to range from seconds to many minutes—has piqued the curiosity of several well-known scientists.

They have become interested for a number of reasons. One is purely theoretical. Here is a new and fascinating phenomenon that needs explaining. Another reason is the obvious application to astrophysics, and many less obvious applications in electronics and solid state physics.

Nuclear power source

But the big payoff is the possibility of a controlled fusion reaction which would lead to cheap, widely available thermonuclear power. Achieving this power millennium, however, requires the creation and maintenance of a ball of plasma. The problem is that the plasma needed for thermonuclear power must be hot—in the millions of degrees. This is so hot that it vaporizes any container. Hopes thus far are pinned on using a "magnetic bottle"—that is, holding the plasma together by means of a magnetic field long enough for the fusion reaction to take place. One of the big centers where research along these lines is taking place is the Oak

Scientists do not believe in UFOs; until recently they did not believe in ball lightning.

Ridge National Laboratory in Tennessee.

Now what better way is there to learn about phenomena like ball lightning than to talk to people who have seen it? In 1960, J. Rand McNally, Jr. therefore asked 15,923 employees of the Oak Ridge Laboratory if they had ever seen ball lightning. To his surprise, 515 answered that they had. They were asked to describe in some detail what they had seen—size, duration, color, movement and other physical properties of the ball.

Results showed that the typical example of ball lightning or, to use its German name, *Kugelblitz,* is a luminous or glowing ball roughly as bright as a strong fluorescent lamp. It may range in diameter from a few inches up to a few feet, with most sightings in the six-inch to one-foot range. It is usually seen after an ordinary lightning stroke. Most of them shine steadily; a few pulsate in brightness. While violet and green are rare, any color can be seen. It lasts anywhere from a second up to several minutes, most often a few seconds.

Some lightning balls fade out slowly; others disappear abruptly, sometimes with a loud bang. They seldom damage anything although they have scorched wood and burned through wires. Normally the ball moves about, sometimes along a conductor or an insulator and sometimes directly through the air.

Do these characteristics sound familiar? UFOs have been reported in a remarkable variety of shapes, sizes, colors and motions. It could just be that when someone sights a sphere of glowing gas he calls it ball lightning, while if the whatever-it-is assumes a different shape, he calls it a flying saucer.

Now, what is ball lightning? Almost all investigators agree that it is a ball of energized plasma. We know of course that plasma is no rarity. But the plasma in stars is maintained by the blazing heat of thermonuclear reactions; the plasma in neon tubes is maintained by electricity; and, the energy of an auroral plasma is provided by incoming energetic particles.

The problem with ball lightning is not only to figure out how it begins, but how it maintains its energy. Recombination of ionized air normally takes place at a rapid rate and couldn't maintain the ball for seconds, let alone minutes. Still we must consider the possibility that the energy is somehow stored in the ball and is slowly released in the form of light. The alternative is that energy is continually fed in by some as yet undetermined process.

This latter possibility lies at the heart of a controversial theory put forth in 1955 by the noted Russian physicist, Dr. Peter L. Kapitza. His

idea and his interest in the *Kugelblitz* spurred interest in the field and led to other theories and to laboratory work which is just now beginning to bear fruit.

Kapitza suggested that the highly electric environment of a thunderstorm could generate electromagnetic radiation. Since this radiation is reflected by conducting surfaces (such as the earth), the radiation would meet itself "coming and going;" where the beams intersect, a phenomenon called "standing waves" would result. Although there is movement in the waves, under the proper conditions the intersection points, called *antinodes*, remain stationary. At these points a region of high electric field is created which ionizes a region of air. Energy is fed in continuously by the radiation arriving from outside. Variations in or movements of the beam could cause the resulting ball of light to move about.

Until very recently it has not been possible to create ball lightning in the laboratory. However, in 1965 it was observed by a manufacturer of radio frequency induction furnaces that occasionally a spark discharge into the air from one of his furnaces would form into a ball or other shape of glowing plasma which exhibited extended lifetimes—that is, one or two seconds.

Thus Dr. Kapitza's theory of thunderstorm-induced ball lightning appears to be a definite possibility. The size of the glowing plasma ball is related to the wave length (and frequency) of the radiation producing it. The typical size of a natural *Kugelblitz* points to the Ultra High Frequency radio band, or 300 to 3000 megacycles. Unfortunately, this kind of radiation has never been detected during a thunderstorm, making it an unlikely source of power for ball lightning. Another objection that has been brought against the theory is that this mechanism couldn't produce the high amount of energy necessary to explain some of the reported occurrences.

Kugelblitz energy

Drs. David Finkelstein and Julio Rubinstein of Yeshiva University in New York have suggested that the *electrostatic* fields found in the vicinity of thunderstorms might be able to supply the necessary energy.

Others suggest that the energy for a *Kugelblitz* is generated by corona discharge from high power transmission lines, since electric lines of force extend for considerable distances from the power lines. Electromagnetic radiation generated by the alternating current flowing through the lines might also play a part. It is noteworthy that many of the reported sightings of UFOs mention that they occurred near power lines.

One of the problems in the corona theory is that despite long years of experience, experts still disagree even over such basic things as the effects of temperature, pressure and humidity in inducing corona on

In 1945 short-lived ball lightning was produced in the laboratory for the first time.

power lines. The effect is very difficult to reproduce at will, at least on a large scale, which is necessary if it is to be studied carefully.

Another theory calls upon a combination of magnetic and electrostatic forces as well as forces of motion, all acting on a special form of plasma. Carsten Haaland of the Oak Ridge National Laboratory suggests that the plasma might take the form of a "trefoil knot", a three-dimensional endless loop arrangement. This form turns out to resemble an inverted teacup resting on a saucer, similar to the "saucer with a hump on it" reported by some observers.

At least two scientists have put forth ball lightning theories in which charged dust particles play a key role. The idea is related to the fact that some reports of ball lightning mentioned the emergence of the globe from a chimney or fireplace, suggesting that soot or dust particles had a role in its formation. This could explain some of the observations of metallic or solid appearances.

For example, it has been shown in the lab that tiny charged ice particles in the presence of a strong electric field will orient their surfaces parallel to one another. In daylight sightings, the angles of incidence and reflection of light striking these thousands of tiny mirrors might be such as to create some of the metallic effects reported. A ring or ball of charged dust particles could also explain a silhouette effect. On the other hand, if electric discharge is taking place within the *Kugelblitz*, it could easily create the illusion of a solid spacecraft with designs or even with small lighted windows.

Is this the answer? Carsten Haaland has worked in the field for some time and has thought about many of the theories that have been put forth. He points out that none of the proposed models fully explains the phenomenon. He believes that there are at least two forms of ball lightning, perhaps more, which would explain why no one of the theories advanced to date explains all the observations.

It is interesting to note that reports of UFOs seem to concentrate in small geographic areas during any wave of sightings. A typical occurrence took place in 1965 at Exeter, N.H. But this might simply indicate that when the required combination of atmospheric conditions comes together, the phenomenon occurs repeatedly.

Of the dozens of UFO sightings at Exeter, reported at length by author John Fuller in his book *Incident at Exeter*, it was noticed that only one occurred in broad daylight. This prompted a policeman to wonder about the "flying saucer:" "Where does it go in the daytime?" An an-

swer is provided by auroras and airglow, which occur during the day as well as at night. Unless extremely strong, they are simply drowned out by sunlight. A comparison of UFO and ball lightning characteristics is shown in the chart.

Those who hold that UFOs are extraterrestrial visitors contend that their behavior demonstrates intelligent control. The "buzzing" cars and planes and trains supposedly indicate an interest in planes, trains and cars. But apparently our visitors are playful as well; their favorite game seems to be "tag". There are reports of jet fighter pilots who have attempted to close in on a sighted object, only to have it zoom ahead when the aircraft approaches. The UFO might then "wait" until the aircraft again approaches, after which it zooms away again. Sometimes the UFO circles the craft or just maintains a certain distance.

It seems obvious to anyone who is familiar with the subject that the phenomenon of electrostatic attraction and repulsion may be at work. Vehicles, as we know, often develop charges. Aircraft in particular sometimes carry a great deal of charge. A bundle of charged air would be delighted to play tag with a strongly charged object.

Among other strange aspects of flying saucers is the fact that they sometimes change size, color and shape while being watched. These are precisely the changing characteristics one would expect if the objects were plasma containing a variety of different elements and contaminants being stirred by a gentle breeze. Some UFO and ball lightning viewers have reported minor facial burns, or a "prickling sensation." The latter sensation is no novelty to anyone who has experimented with electricity.

Probably the most remarkable of the characteristics of UFOs is their apparent ability to stop or even reverse their direction instantly, or to make abrupt right angle turns. Studies of the entire universe have never revealed a single instance where Newton's laws of motion didn't hold.

But if UFOs are plasmas, this scientific inconsistency disappears, for the total mass of the particles involved is infinitesimal even though the apparent size may be large.

The speed of UFOs is another factor that bears investigation. When they move away from an observer, for example, they are often said to travel at unbelievable speeds. But it is more likely that what appears to be a spaceship or other object leaving the scene is nothing more than a shrinking object—a plasma which is losing its grip on life—an optical illusion.

Believers place great emphasis on numerous radar sightings by air defense and traffic control radars. They often use this as "evidence," and point out the "fact" that a blip on a radar screen always corresponds to a reflection off a solid surface. But it doesn't. Auroras, for example, often send back radar

A speeding UFO may be nothing more than a shrinking plasma—an optical illusion.

echos, and no one has bumped into an aurora yet.

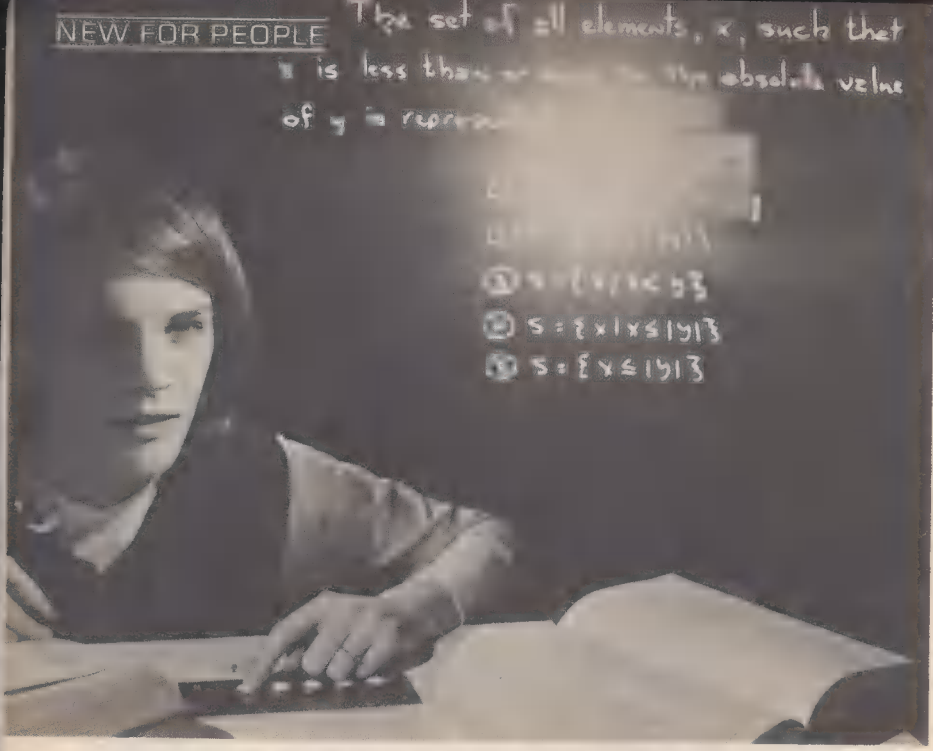
Dr. Uman of Westinghouse suggests several possible tests which might help an observer to decide whether he is witnessing a solid object or a ball of ionized gas. Several persons reported that their automobile radios had briefly become inoperative when the object came near. If it is a gas discharge it should generate radio noise. If you have a transistor radio, tune it in between any two adjacent stations. This will be easier at the low end of the dial. Then turn the volume all the way up; you'll hear radio noise if it exists.

The prism test

Another test is to view the object through an inexpensive optical prism or transmission grating. If the object is a solid which is reflecting sunlight or most kinds of artificial light, you will see a continuous spectrum like the rainbow. But if the object is a plasma phenomenon, a luminous gas, you will see instead a number of individual colors.

Increasing knowledge of plasmas —both their generation and containment—is being gained from work by nuclear physicists in fusion, and by geo- and astrophysicists working in the field of atmospheric electricity. This, along with laboratory work, may show many, perhaps most, UFO sightings to be a plasma phenomena, with other natural happenings explaining the balance.

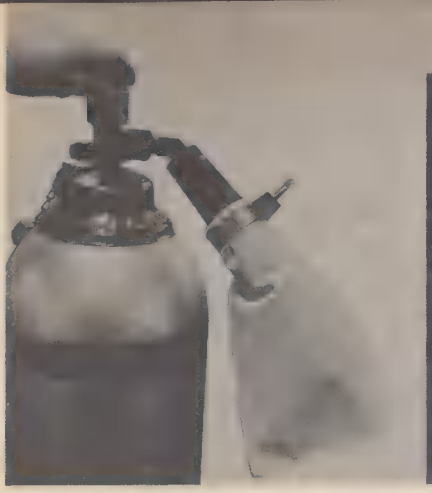
We might say a final word about the greatly increased number of sightings in recent years. It does appear that power line corona and air contaminants play a part. Thus we need only recall that expanding numbers of power lines are being built to operate at ever higher voltages—experiments are in progress with 750,000-volt lines. This could easily increase the number and intensity of the phenomena. As for contaminants in the air—need we say more?



Student Response System installed at Syracuse University by General Electric enables student to answer five part, multiple-choice questions projected on screen by pushing one of five buttons of input unit on desk. Sixth button is used to change a choice.

Electric upholstery shampooer, designed by Glamorene, cleans with circular scrubbing motion. The unit is held by stretch band, leaving the fingers free to release shampoo as needed. The unit is available from most hardware and department stores.

Pil-Tab Pulverizer provides the answer for persons unable to swallow pills. It crushes a pill in the spoon from which it can be taken without spillage or loss of dosage. Leisure Industries 105-10 Metropolitan Ave., Forest Hills, N.Y. 11375.



Instant dry ice is made by Redi-ice, a device manufactured by Metallurgical supply. A metal adaptor, nozzle and cone attaches to any standard carbon dioxide CO_2 cylinder equipped with siphon tube. P.O. Box 12037, Houston, Texas, 77017.

Not a roller coaster but an artist's conception of a Goodyear PeopleMover now at Disneyland. The vehicles could transport people from shopping districts to bus stations and parking lots or vice versa. Cars are powered by power-driven wheels.

Broadcasting Sandals aid in diagnosis of hip-joint conditions by measuring exact pressure patient puts on feet when walking. Flexible metal filigree sheets between sponge rubber layer in each heel operate with battery-powered electronic circuits built into sandals to record various weight pressures and radio them to pick-up wire. Messages are amplified and sent to display recording instruments that give accurate pressure measurements.

ZOOLOGY

The great rabbit war—

Talk about population explosions! One day there were a couple dozen pairs of wild rabbits in Australia. Then, they were eating the Aussies out of house and home.

by Howard Earl

THE odds were tremendous—500 million rabbits battling 10 million humans. The stake was enormous. If the rabbits won, the Australian economy would crumble and the country deteriorate to something akin to what is termed in the States "a distress area".

Events leading to the great battle began with no indication of what lay ahead. In 1859 two dozen wild rabbits *(Oryctolagus cunniculus)* were imported from England by Thomas Austin and liberated on his grazing property near Geelong, Victoria. Why the Australian wanted to start a colony of wild rabbits never has been explained. Domesticated hares had been brought to the country as early as 1788 when colonization was begun by the British.

Those early rabbit imports were probably special types bred over the years in Europe for their fur and for food. It is well known that in the days of sailing the danger of shipwreck was very real and rabbits were liberated to breed on islands to provide food. But they were not such prolific breeders as the wild imports in 1859.

Unfortunately for Austin and his fellow Australians, their country boasts certain types of soil favoring native flora not found elsewhere in the world but which seems to accelerate propagation of the *Oryctolagus cunniculus* imported by Austin. Adding to this difficulty, the generally mild, temperate climate of Australia extends the breeding season for a longer period than in many other countries.

Such rabbit-promotional features combined to populate Austin's acreage with rabbits far in excess of the human and other animal population. But that was not all.

The rabbits not only increased in numbers at an enormous rate but as they multiplied they spread over greater acreage. By 1880 they had reached their first barrier, the Murray River, 150 miles from Austin's

Australian News and Information Bureau

farm. By 1886 the fertile little creatures were 400 miles to the north in Queensland. They spread over the land at the rate of 70 miles a year and increased by the millions.

Sexual maturity is attained at about four months of age and the period of gestation is only 28 days. The young are capable of fending for themselves within three weeks after birth and their mother deserts them within that period. A doe's first litter may be as small as three or four but soon she settles down to what seems her sole purpose—full reproductive capacity—and gives birth to litters of a dozen or more. It is believed that in Australia the average wild doe rabbit will probably produce four or five litters annually. A mature doe's average annual progeny varies from 48 to 60.

The continuing increase in the population pushed the rabbits to new frontiers until their only limitations were the oceans, the tropics and heights above 5000 feet because the diminishing oxygen supply at greater heights lessens their mobility, reducing their propagational desires.

The day came when the southern two-thirds of Australia was overrun with rabbits, 500 million of them. They occupied deserts and even highlands where the snow was thick in winter. Forests remained free except at the margins and clearings and some heavy soils and dense pastures seemed unsuitable.

The 500 million rabbits not only became a wearisome nuisance, but they soon were affecting the economy of Australia to an alarming extent. They chewed off the grass that supplied food for grazing stock. They ate growing crops and killed young trees in fruit orchards and forestry plantations by gnawing off the bark. The result was little short of catastrophic.

Sheep depend entirely on natural pasture. The wild rabbits, as the saying goes, "got there firstest with the mostest" and left inadequate

grazing for the sheep. As a consequence the sheep population in the western division of New South Wales dropped to about six and three-quarter million in 1951 as compared to 15 million in 1891.

The first determined effort to stem the spread of the rabbits came in an attempt to fence them in. At the turn of the century, barrier-netting fences were erected with high hopes that the rabbits would be confined to areas they already had colonized and assure regions beyond these colonies permanent protection.

Barrier fences totaling several thousand miles in length were erected, some across deserts and unexplored country lying on the edge of the Great Sandy Desert. Toting water and food for men and animals as well as the material for the fences proved costly and backbreaking. In the desert area the fencing operation cost $400 a mile, which was not peanuts in the early 1900s.

The fence-building experiment proved an unhappy failure. A new weapon, however, had loomed up on the horizon.

Australian biologists had been investigating the possibility of using a virus-caused disease to control the rabbit population. The biologists learned the myxoma virus of South America makes its natural host the South American rabbit of the genus *Sylvilagus*. The virus caused a mild disease but did not kill its host.

Through experiments the researchers learned the myxoma virus was dangerous to one animal—the European rabbit—the little creature which Thomas Austin had imported from Europe and which now was causing chaotic conditions in Australia's economy. The virus infected the rabbits with myxomatosis, a disease which proved nearly 100 percent fatal.

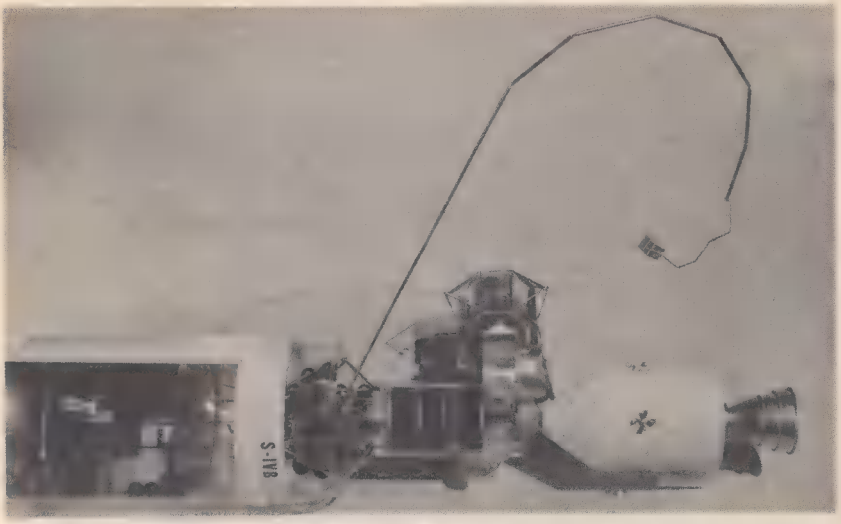
Within a three-year period—1950-1953—the rabbit population dropped from an estimated 500 million to about 100 million. Concurrently, the wool clip from sheep increased by 70 million pounds.

Less deadly virus

As early as 1952, however, evidence began cropping up that the virus was becoming less virulent. It had mutated and evolved a new strain less harmful to its host. Less than 90 percent of infected rabbits died and those which succumbed lived longer than their infected predecessors, meaning the mosquitoes had a greater chance of biting rabbits harboring the less virulent virus. Compounding the situation, the rabbits evolved resistance to myxomatosis. Not all of them to be sure. But the fear is that in time the entire population of wild rabbits in Australia may develop complete immunity to the disease. The animal is still found over a vast area of the country, but its numbers are much fewer now.

Though additional measures have been taken to control population growth, including destruction of rabbit burrows and the use of chemicals, rabbits may continue to be an ever present blight.

Science Month



An orbital workshop for astronauts in outer space, this serpentine actuator operates with hinged joints controllable from either end. It's essential purpose is to move items of hardware from one part of orbiting assemblage to another in zero gravity.

"Space cherrypickers"

A snake-like device called the serpentuator is designed to locate and handle tools for astronauts in manufacturing and assembly operations in outer space. Developed by NASA-Marshall Space Flight Center for use in zero gravity, the serpentuator consists of links connected by powered hinges. The long devices cannot be used on earth because they are not self-supporting under gravity.

Two basic versions of the serpentuator are under study. A small five-link device—inserp—folds up like a yardstick and is being developed for use inside a space station. Power for the small device will be supplied by either a hand pump attached to each end or batteries. The hinges are moved by hydraulic fluid.

The second version is called an exserp and can be used for activities outside the space station. Twelve hinged links, each eight feet long, would give the device a total length of almost 100 feet with the hinges powered by electric motors. One end of the linkage system is connected to the space station while the other end is free to move about.

The developer of serpentuator can see no reason why the links could not be made much longer in order to extend the range to several

hundred feet or yards. Serpentuators with such reaches, or longer, could be used as "space cherrypickers" to move tools and equipment during assembly, repair or manufacture in outer space.

Youthful destroyer

Now we find that one man's meat is another man's poison extends to insects. Scientists have discovered that a synthetic hormone that keeps insects young may be a potent destroyer of the human body louse. The hormone kills the pest and prevents its eggs from hatching.

The synthetic material is a golden oil which scientists believe contains six ingredients with juvenile hormone-like activity. The juvenile hormone prevents insects from maturing and from progressing from one normal developmental stage to the next, as in their normal metamorphosis. The synthetic hormone can be produced from chemicals easily obtainable in the laboratory. Although field tests of the hormone's effects on lice have been considered, they have not been conducted.

A colony of human body lice in the laboratory of the Harvard School of Public Health was used for experiments on control of the insects by the synthetic hormone. Control of body lice is important because they transmit epidemic typhus from man to man and are blamed for many of the catastrophic outbreaks of pestilence in human history.

The value of the synthetic hormone as a killer of body lice and controller of its propagation is the more important because the insect has become resistant to nearly all known insecticides in many parts of the world. This means that in areas where it flourishes there remains the constant threat of epidemic typhus in the wake of wars, natural catastrophies or other circumstances in which humans exist in filth, poverty and hunger.

Development of the synthetic hormone by Dr. Carroll Williams of Harvard University's biological laboratories and Dr. J. W. Vinson of the Harvard School of Public

A monstrosity in appearance but an invaluable aid to warfare is the tank bridgelayer centurion. It not only may be useful in Vietnam but could be used advantageously in flooded areas in America.

Health was reported in the Proceedings of the National Academy of Sciences.

Two brains per person

You may not accept the theory but scientists now believe you have two brains—left and right—with each capable of functioning independently of the other. This theory evolved from recent experiments with persons whose brains have been divided surgically. The experiments also demonstrated that in many situations the right-hand side of the divided brain does not know what the left-hand side is doing and vice versa.

It was learned that when visual information is presented to the right side of a person with a surgically divided brain, he is unable to say what he saw. Why? Speech is controlled by the left hemisphere of the brain and with the two hemispheres divided, the patient was unable to transfer visual information from one brain to the other. However, he could point out the object he had seen from among many placed before him.

Another intriguing discovery was that information presented to the left side of the body is processed by the brain's right side and vice versa. It was discovered, too, that one hemisphere can give hints to what the other is doing. This was demonstrated by flashing green and red lights. If a red light was flashed to the right hemisphere and the patient guessed red, he would stay with his guess. But if the flashed light was green and the patient guessed red, he would frown and say he meant to say "green".

Actually, the right hemisphere saw the green light and heard the left hemisphere make the guess "red". Knowing the answer was wrong, the right hemisphere caused the frown and cued in the left hemisphere to correct the guess.

The experiments were conducted during the past five years by Dr. Michael S. Gazzaniga, psychologist at the University of California in collaboration with Dr. Roger W. Sperry, a psychologist at the California Institute of Technology who has been doing split brain studies on monkeys for 12 years. Dr. Gazzaniga described his findings in *Scientific American*.

Persons with very severe epileptic seizures underwent surgical separation of the brain's two hemispheres. It was found by severing the bundle of nerve tissues joining the two brains that seizures arising in one hemisphere would be prevented from spreading to the other. The severity of the seizures also were greatly diminished.

Pots and pans to missiles

From a coating for pots and pans to a new space fuel for satellite thrustors is the story of Teflon at General Electric's Valley Forge Space Technology Center. GE scientists and engineers have demonstrated with tests that Teflon, with

Smoking monkey uses special mask containing cigarette apertures at the Soviet Scientific Research Institute of Oncology near Moscow. Purpose: to probe any links between cigarette smoking and cancer.

a chlorine-carbon bond, is ideal fuel for a micropound thrustor under development at the Center's vacuum chambers.

The micropound thrustor is a tiny engine weighing less than one pound and is not quite two cubic inches in size. Known as SPET (Solid Propellant Electric Thrustor), the engine was developed for three axis stabilized, gravity gradient and spin-stabilized vehicles. It is intended for such functions as attitude control, station-keeping, spin maintenance and precision as well as trajectory adjustment.

Teflon was discovered as a possible fuel by accident, according to Dr. Aldo V. LaRocca, inventor of SPET. Previous tests of the thrustor with such fuels as phospho-nitrilic chloride revealed that the fuel was not ablating cleanly. It left a deposit in the second stage copper barrel which, after several million firings, affected engine performance. When Teflon lining was inserted in the barrel it ablated cleanly, leaving virtually no deposits and it added fuel which increased SPET's thrust.

Initial examination disclosed that Teflon possessed the characteristics required by SPET fuel; low vapor pressure, low surface energy, high density, good wetting properties and good breakdown characteristics. It is insensitive to heat, humidity, acids, salt and atmospheric contamination. It can be made into a wax consistency by boiling at 250° F. in a vacuum and still retain its wetting properties.

New evidence—old theory

Those theorizing that Africa and South America were joined together as one continent about 200 million years ago now have new evidence to substantiate their theory. The theorists rested their previous claims on similarities in coastal formations, fossils and land structure on opposite sides of the Atlantic Ocean.

Geological surveys years ago revealed a sharp boundary between two major geological provinces in West Africa. The boundary separating the two extensive regions with sharply differing ages ends abruptly at the coast of Ghana, near the city of Accra. On the eastern side of the boundary, the rock is about 500 million years old, but west of

the boundary rock is at least two billion years old.

Dr. Patrick Hurley, professor of geology at the Massachusetts Institute of Technology, thought the boundary had its counterpart in northern Brazil, somewhere near Sao Luis in Sao Marcos Bay. He arranged to get samples of surface rock and core specimens from the remote area.

The samples and specimens were dated radiometrically at MIT's mass spectrometer and showed a geological age boundary almost identical to the one in Africa that emerges just south of Sao Luis, almost exactly where Dr. Hurley had predicted it would.

"Cross-breeding" missiles

A "cross-breeding" of missiles has produced the AIM-4D with characteristics making it specially suited to the needs of limited war and aerial combat between fighter and aircraft. The newest missile in the U. S. arsenal has blasted more than a score of jet target drones from the sky while being tested for its effectiveness in air-to-air combat.

An official of Hughes Aircraft Company—Dr. Warren E. Mathews—stated that historically air-to-air missiles have been designed to intercept invading enemy bombers approaching on a fixed course. Hitting a fast fighter plane that is manuevering to escape is much more difficult and presents an entire new set of problems.

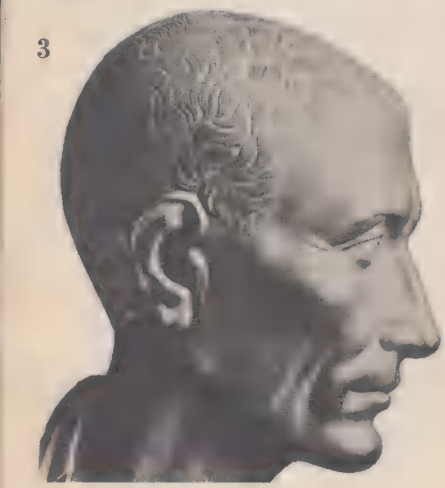
Tests so far of the small infrared AIM-4D, according to Dr. Mathews, show the missile can score hits in adverse situations where other infrared missiles would have been severely handicapped.

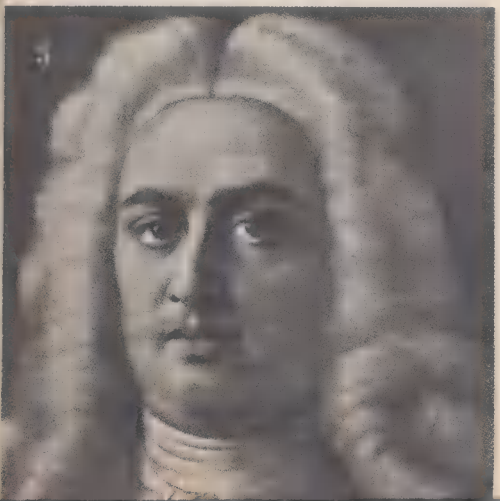
Getting inside a flame

How much sulfur is oxidized in the combustion process? Scientists at Battelle Memorial Institute are trying to determine the answer because it can be very important to air pollution authorities and to corrosion engineers. Unfortunately, the oxidation kinetics of sulfur in a flame has had limited attention.

The apparatus used by the scientists—Arthur Levy and Dr. Earl L. Merryman—consists of a glass-walled burner with a quartz microprobe that can draw samples from selected portions of the hydrogen sulfide flame. These samples can be passed either directly to a mass spectrometer where the gaseous products are analyzed, or to a Toepler system for wet analysis of the combustion products.

Temperature profiles of the flame are obtained by a fine platinum/platinum-rhodium thermocouple coated with silicon dioxide. Such data enables the researchers to determine the microstructure of the flame and trace the pathways by which sulfur is oxidized. The information ultimately could be valuable in developing methods for reducing atmospheric pollution by sulfur oxide gases.





Victory

K.F.S.

Epilepsy is a serious but in no sense disabling disease as the above gallery of well know victims testifies. They include: 1. Violinist Nicolo Paganini, 2. The Prophet Mohammed, 3. Roman conqueror, Julius Caesar, 4. The poet Lord Byron and 5. Composer George Frederick Handel.

over epilepsy

by Andrew Hamilton

EPILEPSY has been called the "falling down" disease because some of its victims lose consciousness, go into convulsions and fall to the floor. It is also referred to as the "hush-hush" disease because centuries of fear, superstition and ignorance have grown up about it.

Epilepsy is a set of symptoms resulting from an excessive discharge of electrical energy in the brain. Millions of neurons or nerve cells release this energy in an abnormal way—causing loss of consciousness and convulsive movements of the body. The basic reason for abnormal electrical discharge in the brain may be a birth injury, a blow on the head, a brain tumor, a fever or an infection. The notion that the affliction is hereditary has been largely disproved.

A long list of well-known historical figures have been victims: Alexander the Great, the philosopher Socrates, the Prophet Mohammed, the Roman conqueror Julius Caesar, Blaise Pascal the mathematician, violinist Nicolo Paganini, composer George Frederick Handel, George Gordon Lord Byron, Alfred Nobel and the painter Vincent Van Gogh.

Today 1,800,000 Americans are said to suffer from some degree of this disease. Frederick Gibbs, brain specialist at the University of Illinois, thinks the total number of victims of this disease may be even higher.

In the past decade, science has made significant progress in the battle against epilepsy. It is attacking on three fronts—drugs, surgery and social attitudes—and seems to be winning.

Doctors recognize three basic kinds of epilepsy:

1. *Grand mal* or "great sickness." The patient is seized by violent shaking and often falls down. Loss of muscular control may cause him to bite his tongue, emit saliva or lose control of bowels or bladder. During the seizure he is unconscious and feels no pain. The condition lasts from 30 seconds to one minute, and the victim emerges in a groggy state. He may even stagger as if trying to re-orient himself. In this state some epileptics have been arrested as drunks.

2. *Petit mal* or "little sickness." This form of epilepsy often goes unnoticed because the only symptoms are brief, involuntary muscular twitches such as fluttering of the eyes, nodding of the head, jerking of the arm. Sometimes the only symptom is a glassy-eyed stare. Petit mal manifestations occur mostly in school children and

momentary blackouts may occur from 10 to 100 times a day. They last only 10 to 20 seconds, during which a sufferer may continue to walk, swim or ride a bicycle. Consciousness returns abruptly without unpleasant side effects.

3. *Psychomotor* epilepsy. Symptoms may range from a simple, involuntary smacking of the lips to a prolonged, sulky withdrawal during which the patient may be physically aggressive if abruptly restrained. These actions occur while the patient is totally unconscious. Before lapsing into unconsciousness, some psychomotor epileptics hear a recurring musical theme. Some recall a strong, distinctive odor. Others visualize the repetition of dream-like hallucinations.

Promising methods

New methods of controlling epilepsy are most promising. But they were a long time in coming. At the time of Christ, bystanders who witnessed epileptic seizures would spit on the afflicted persons to ward off the "evil spirits" they believed to be the cause of the trouble. In the Middle Ages victims were sometimes branded with red-hot irons to drive out the devil within.

Not until the 19th century did an English doctor stumble on the fact that sedatives called bromides were an aid to epileptics. Around 1900, phenobarbital was found to be even more effective. By 1940 a drug was discovered that would give relief without causing the drowsiness brought on by the other two. This was dilantin, a chemical that suppresses both grand mal and psychomotor seizures in many epileptics. Since then, some 25 drugs have been discovered—among them mysoline and celontin.

Nationwide effort

A nationwide team effort is now underway to test new drugs quickly and thoroughly, and to make certain that only superior drugs are prescribed. Under the leadership of Dr. Francis Forster, a University of Wisconsin neurologist, four universities and three hospitals are pooling their talents and facilities to arrive at fast, accurate decisions as to the efficacy of new drugs. The institutions include the University of Wisconsin, the University of Pennsylvania, the University of Florida and the University of California, Los Angeles, the Montreal Neurological Institute and two state hospitals.

One of the new drugs called LA-1 was almost withdrawn from production because early reports were inconclusive. But testing continued and now LA-1 is proving to be of great value in treating the kind of epilepsy spasms that occur in infants and children.

Because of their evaluation program, doctors today can choose from a broad range of chemical remedies—all of which are nonhabit forming—and find one that will deter or stop the type of seizure

Certain psychomotor forms of epilepsy are treated with radioisotopes of Yttrium-90.

that afflicts a particular patient.

The greatest challenge at present is certain kinds of psychomotor epilepsy that do not respond to drugs. These seizures are caused by electrical irregularities in two areas of the temporal lobe of the brain—the amygdaloid area and the hippocampus.

Multipoint electronics

Dr. Robert Rand and Dr. Paul H. Crandall of UCLA are working to perfect a technique that was tried more than five years ago in Paris. Dr. Jean Talairach, a French surgeon with whom Dr. Rand had studied, placed multipoint electrodes in the temporal lobes of his patients to determine the areas where electric discharges were heaviest. Once he found the trouble zone, he inserted a tube into the area and through it injected a tiny, pill-like radioisotope of Yttrium-90. The beta radiation produced by this little speck destroyed the epileptogenic tissue and the seizure eventually subsided.

The method developed by Dr. Rand and his colleagues makes it possible for patients to keep several needle-like electrodes implanted in their temporal lobes for as long as three weeks while variations in electric current are fed into a tape recorder or a computer.

When points of the heaviest electrical discharge are precisely located, they are removed surgically. Of 21 such operations performed to date, 15 appear to be successful in eliminating the causes of seizures. At least three patients have been without seizures for six months to three years—or long enough to indicate permanent relief.

Unlike a lobotomy, surgery on epileptics involves removal of such a small amount of tissue that there is no impairment of mind or memory, Dr. Rand points out.

One of the greatest strides in the treatment of epileptics is recognition that they are in every other way normal and can be helped to live happy and productive lives. This involves changing social attitudes of both epileptics and the public at large.

Dr. William G. Lennox of Harvard University studied the records of nearly 2,000 sufferers. He found that 67 percent had average or above-average intelligence, that 23 percent were slightly below average, and that only 10 percent were grossly deficient.

In another study that involved 50,000 patients, only 5 percent of those with grand mal or petit mal showed any sign of mental retardation. Only those with psychomotor epilepsy indicated a higher percentage of brain damage or personality disorder.

Epileptics should be aided to live normal lives and practice moderation. Emotional strain or excessive fatigue can often set off seizures.

Points to remember

If a person in your vicinity has a seizure, remember these points:

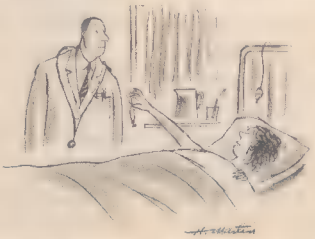
- Keep calm, he is not in danger.
- There is no need to call a doctor unless he hurts himself in falling, or if the attack continues more than 15 minutes.
- Don't try to give him liquids or slap him awake while he is unconscious.
- When a convulsion starts, lower him to the floor, place him away from furniture or heaters, put a pillow or coat under his head.
- Place a spoon or stick between his teeth to keep him from swallowing his tongue.
- When the seizure is over, help him to find a place to rest or sleep.

One of the best forms of therapy for epileptics is a job. Most of them can work, and should. In 1956, Dr. Frank Risch, Veterans Administration psychologist, organized an electronics factory for epileptics in Los Angeles to prove that victims of this ailment were not just "human junk." Similar plants were also established in Jamaica, New York and Phoenix. To date some 1,200 epileptics have been successfully employed and 300 placed in private industry.

Although epileptics are discriminated against in a number of cities and states, the bars are coming down. In Ohio, epilepsy is covered in workmen's compensation second-injury funds. Wisconsin and Ohio have a plan of medical certification of epileptics for driver's licenses. Boston sponsors an education program about epilepsy in schools and admits educable epileptic children.

"The outlook is optimistic on all sides," says Dr. Charles H. Markham of UCLA's Neuropsychiatric Institute. "The teamwork of doctor and patient, researcher and counsellor—plus an enlightened understanding on the part of the public—are helping epileptics to live a more abundant life.

"Complete control of seizures is not too much to hope for, and perhaps within a single generation combined forces of medicine and surgery will achieve the final victory over epilepsy."



"Just in case you may need it, here is the key to my heart."

Derek Miller checks breathing equipment of one of the eating experiment subjects.

Why some people get fat

A group of British students walking around with oxygen masks clamped to their faces may help provide some of the answers to the agonizing question of, "Why some people get fat?"

The masks are not meant to give the students cleaner air to breathe, they breathe ordinary city air; it's what they breathe out through their masks that is important, and it is measured in the apparatus in their packs—so that the amount of oxygen they consume can be tallied.

It's all part of an experiment being conducted at London University's Department of Nutrition to find out, simply, whether people get fat by overeating—or whether something else is involved. The way out gear worn by the students is to measure their metabolic rate—the rate at which they burn up oxygen in their bodies, while they are living their normal lives.

The twelve student volunteers are being paid £1 a day (about $2.80 in U.S.) to eat too much, and to wear the masks and carry the nine-pound packs.

The twelve have been divided into two teams—named the "gorgers" and the "nibblers", to simulate the type of eating habits adopted by most people. The Gorgers have to eat meals of 2,400 calories (an average person's daily need) several times a day. The Nibblers eat a similar amount—spread over fourteen "nibbles" of candy bars, sandwiches, and the other things that we all nibble at and then wonder why we have put on weight. They start at 9 a.m. and eat their way through the day, every hour, on the hour until 10 p.m.

In addition to their masks and packs, each student in the experiment is fitted with a heart-beat counter—two small electrodes taped to their chests which convert the electrical heart-beat impulses into a record of heart rate. They also carry a pedometer, to measure the distance they travel each day. All vol-

unteers are weighed at short intervals and complete records are kept of almost everything they do throughout the day. In this way, accurate details are recorded of the amount of food—in calories—they consume, the amount of oxygen they consume, the energy they use up, their heart-beat rate and their weight throughout the duration of the experiment. The data will then be fed to a computer and will help Derek Miller, a nutrition expert, learn more about why we put on weight.

"We were trying to find out whether obesity is due to gluttony," says Miller, "and it looks as if the answer is no—at least in some cases. Some people don't put on weight, however much they eat—and we want to find out why. It may be that we can develop a drug that helps people to shed unwanted weight.

The experiment found that the students put on weight during the first two weeks, but after that they did not continue to gain no matter how much they ate.

"Although it may seem that fatness is not linked to overeating, this doesn't mean that you can go and eat what you like. All these students are under 25, and it seems that age has a lot to do with it. Once you get past a certain age, everything seems to go to your waistline."

Top: Two volunteers wearing elaborate equipment are questioned by a puzzled London Bobby. Center: "Nibblers" and "Gorgers" at work in the nutrition laboratory. Left: More experimental equipment; electrodes taped to chest and pedometer on belt to tell how far subject's walked.

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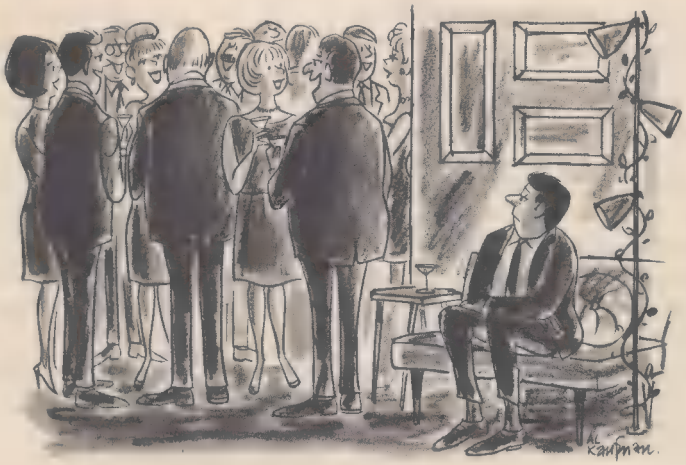


You don't have to be lonely

Loneliness, says psychologist Allan Fromme, is like the common cold—easy to catch, hard to cure and hardly anyone is immune.

by John E. Gibson

You can be alone without being lonely, and you can be lonely without being alone. In fact, the worst kind of loneliness is the kind you feel when you're with other people. Conversely, you can be isolated from people for appreciable periods of time (a cabin in the woods, a hideaway by the sea) without experiencing the slightest feeling of loneliness.

Nevertheless, loneliness probably does more to blight people's lives—make them feel miserable, unhappy and unwanted—than any other factor. What makes loneliness tick? Is there more than one variety? Why do some people actually prefer to be lonely? And is there any simple cure for loneliness? The noted psycholo-

gist, Dr. Allan Fromme, has made an intensive study of loneliness to find out why it affects people the way it does and the most effective ways of dealing with it.

What is loneliness?

"Loneliness," says Dr. Fromme, who reports the findings of his studies in his latest book dealing with human relationships, *The Ability to Love*, "is like the common cold—scarcely anyone is immune to it. Most people have experienced the infection at some time, and some people seem to be suffering from it almost all the time. Some people are more susceptible, others less so. Like the cold, loneliness is easy to catch, hard to cure, rarely fatal but always unpleasant and sometimes wretched almost beyond bearing."

Aloneness—solo pleasures

But aren't there advantages to being alone?

Loneliness has no advantages. Aloneness, however, has both advantages and disadvantages. Dr. Fromme describes both sides of the coin: on the credit side, there are many worthwhile tasks that demand long hours of solitary persistent effort. For thinking, contemplating, working out problems, making decisions, it is necessary to be *alone*. There are pleasures too in solitude; making no effort to accommodate oneself to another's needs or wishes; having no thoughts or feelings except for oneself.

But these, he notes, are dangerous pleasures. People too easily become addicted to solitude, to the relief of not having to bother about other people—and the solitary world becomes ever narrower and more inward. Anxiety grows on solitude, and he also finds it "a breeding ground for the diffuse, unfocused, pervading uneasiness that makes us vulnerable to chronic worry." Almost anything can become a cause for concern to the solitary person; almost anything can make him fearful.

We tend, he observes, to equate a love of solitude with a strong individuality. But it can also become an unhealthy habit of withdrawal, or rejection of others out of fear of oneself being rejected. The sense of oneself as an individual thrives best, not on solitude, but on interaction with other individuals. His findings further indicate that "When we are too much alone our identity tends to lose its dimensions, to become vague in its boundaries. We feel ourselves most clearly defined in our impact on others, and theirs on us."

How can you tell if a person is lonely?

It is often very difficult. Dr. Fromme finds that lonely people generally try to mask their loneliness, often going to great pains to do so; seeking in various ways to give the impression that they are completely self-sufficient, or that their life is so busy and crowded with interests that they scarcely have time for them all. It is as though they felt loneliness were something that must be carefully hidden; that to admit it would

The lonely person tries to make his life look so crowded with interests, he barely has time for it all.

somehow be humiliating, a confession of failure.

The specialist offers one clue as to how to spot the lonely person; often their polite reserve is a tip-off. That's all we generally see in such people, he says. This does not mean, of course, that every person with a polite reserve is lonely—but it is frequently a valid indication.

How does the typically lonely person feel?

Dr. Fromme gives us a thumbnail picture of the "lonely soul"; everyone he sees seems to him preoccupied with the excitement of living and being involved with people; no one seems to be lonely except himself. Ironically, many of those whom he envies are just as cut off from people as he is—and are actually going home to marriages or families in which they are just as lonely as though they lived alone.

But isn't marriage and family the answer to loneliness?

The lonely person, says Fromme, may actually have virtually no human contacts or acquaintances—yet he could be just as lonely if he were surrounded by a family. He would then explain his loneliness by saying that in a house full of people there is no one he can talk to—really communicate with—no one who understands him, no one who really cares about him.

The specialist points out that we unconsciously project onto others the failings we find it unpleasant to face in ourselves. "There is," he finds, "much projection in loneliness. The lonely individual who complains that no one cares about him may actually be complaining that he does not care about anyone. That his loneliness is self-created is very hard for him to admit."

He observes, however, that it makes no difference whether a person's loneliness is the result of his own doing or otherwise. It is no less painful whatever its cause. And no one can do anything to remedy it except the sufferer himself.

What are the two basic types of loneliness?

Exterior loneliness—a temporary thing, caused by sudden change in situation or environment; and *Interior loneliness*—stems from within the person and tends to be more or less permanent, unless cured by a change in attitude and outlook.

Dr. Fromme illustrates the two types of loneliness thusly: "Anyone can feel lonely in a strange place, away from familiar scenes and people, but that is a transient, situational kind of loneliness. But if an individual remains for any length of time in the new place and continues to feel deeply and pervasively lonely —rather than temporarily homesick —it is then the unfortunate *interior* loneliness that one may suffer anywhere. This is the kind of loneliness one takes along wherever one

may go, with whomever one may be. It is an inability to reach out toward others on some level of feeling and understanding and to draw their feeling and understanding comfortingly toward oneself. It is a basic sense of unconnectedness with people; in essence the denial of a deep need that we all share, the need to form relationships, to become attached, to love and be loved in some way."

Love others, know yourself

We need these relationships, the psychologist points out, for the expression of deep feelings, the kind of feelings that make us truly aware of ourselves as individuals, as entities. We seek such relationships. And when we fail to form them, we are lonely.

How many close relationships do you need?

Undoubtedly, says Dr. Fromme, a person realizes himself most fully in a single profound relationship with another human being—one with whom he is very much in harmony. Those who succeed in building a good marriage probably come closest to this ideal. But even a very good marriage does not necessarily meet all the needs of its partners. And the more facets we have to our individuality, the more we have a need to extend our relationships to include other people as friends, even though the principal activities of our lives cluster around a single central relationship.

How can you cure loneliness?

Dr. Fromme's answer is succinct: Make a habit of people. This, he observes, is such a simple and obvious approach that we may wonder why lonely people don't seize upon it. We don't need to wonder—they tell us why. They give us a great many reasons. They are too busy with their work, they simply have no time for people. Or they find most people too uninteresting, most relationships too superficial and banal; they demand more depth and intensity in their relationships than most people are able or willing to give. Or—they tell us—they have been disappointed in people too many times; people are insincere, hypocritical, not really interested in anyone but themselves. These are all good and convincing excuses. But they are rationalizations rather than reasons. The lonely person likes to blame anyone but himself.

For those who are lonely and would like to do something about it, Dr. Fromme gives you these rules.

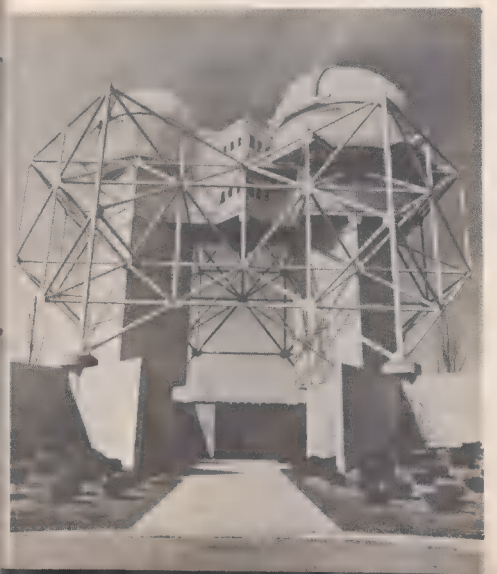
1. Keep moving. Let no week go by without giving or accepting an invitation. If no one calls you, call someone.
2. Practice speaking to new people. If necessary, learn lines in advance: what to say at cocktail parties, buffet suppers, etc.
3. Remember, the easiest social skill, and the most endearing, is to know how to listen.
4. Remember that *making a habit of people* means finding every possible way to be with people, to do things with people, to become involved with people.

Little men from Mars

DON'T bet on seeing any little men from Mars during your lifetime. That warning comes from Dr. S. Fred Singer, professor of atmospheric science at the University of Miami. He says the atmosphere of Mars is a primitive one in comparison to the earth's, which is the most advanced in our solar system.

The atmosphere of Mars consists almost entirely of carbon dioxide with perhaps a little nitrogen and trace constituents of other gases, while the atmosphere of the earth is about four-fifths nitrogen and one-fifth oxygen. The pressure of the atmosphere on Mars is less than one percent of that on earth with the Martian atmosphere containing only minute amounts of water vapor. There are no oceans on Mars.

Twin-towered $1.1 million astronomical research center at Northwestern University houses telescopes, computerized photometers, and many similar instruments.



"We assume that Mars was formed at a time and in a manner similar to the other planets in the solar system, from the condensation of dust and gas," notes Dr. Singer. "It formed cold and not initially molten and started its career with no appreciable atmosphere. All of these conditions are generally thought to hold for the earth."

Mars is one and one-half times farther from the sun than is the earth, consequently colder. Mars experienced no volcanism, had no molten core and no magnetic field to shield it from the solar wind. It did not capture a substantial moon as did the earth with the consequent heat-producing stresses and strains that affected the earth and its atmosphere.

"Since the Martian atmosphere is so heavily composed of carbon dioxide," says Dr. Singer, "it may support life, even if much more primitive than life as we know it on earth. Without the natural early assets of the earth, it could take Mars a million or billion years to develop an atmosphere like the one here."

Twin-towered observatory

A $1.1 million twin-towered observatory, housing 40-inch and 16-inch reflecting telescopes, is the nerve center of Northwestern University's observatory system which includes two astronomical stations in New Mexico. The ultra-modern

Submarine used in ocean and fresh-water lake dives in scientific research. Six viewports provide excellent visibility. Sub equipped with TV cameras and lights.

astronomical installation is on a sandy bit of land jutting into Lake Michigan off Northwestern's campus at Evanston, Illinois. From this position the two telescopes command an unusually broad and unencumbered sweep of the northern and eastern sky.

The base of each telescope is 70 feet above ground level, giving the instruments maximum protection from buffeting by surface winds and from image-distorting heat convection currents. The 40-inch reflecting telescope is equipped with image orthicon (television camera tube) devices to extend greatly its range and light-gathering ability. Additional equipment includes computerized photometers, spectroscopes and similar instruments for rapid evaluation of data observed. The 16-inch telescope in the second tower is used primarily for undergraduate study.

Explore Lake Michigan

No Loch Ness monster was found but exciting discoveries were made by University of Michigan scientists during recent deep dives in Lake Michigan in a research submarine. Some 25 miles west of Frankfort, Mich., four of the university scientists went down 912 feet, the deepest dive ever in the Great Lakes and the deepest scientific dive in any fresh water. The journeys to the bottom of the lake were made in Star II, the General Dynamics submarine.

Operation Submich's main purpose was to test the feasibility of submarine research operations in the lake, and they proved feasible. Dr. J. T. Wilson, director of the University of Michigan's Institute of Science and Technology, is looking forward perhaps next year to sampling the last half inch of water and the top half-inch of bottom where biological productivity is teeming. He called this inch the most important in the lakes for scientists studying water pollution and fish propagation.

Longevity of birds

A herring gull found on the shore of Lake Michigan's Little Traverse Bay may have set a world record for longevity among wild birds. Knowl-

edge of the bird's exact age was established by a band which had been attached to the creature's leg June 29, 1930. That day Olin S. Pettingill, Jr., director of the Laboratory of Ornithology at Cornell University, was at Duck Rock, an islet just off Monhegan Island, Maine. There he and three companions banded 19 herrings, then only 10-day-old chicks.

Thirty-six years later a troop of Girl Scouts on Little Traverse Bay came upon a dead bird. One noticed a copper band bearing a number on the gull's leg and urging the finder to "Notify Biological Survey, Washington, D.C." The band was removed from the leg of the deceased gull and mailed as directed.

The next nearest known record for the life-span of a wild bird is that of another herring gull in Europe. It lived 31 years and 11 months.

Wild songbirds are known to have lived 16 years. But in captivity and free from the hazards of life in the wild, the picture is much different. A protected eagle owl lived to be 68-years-old and an Andean Condor lived to celebrate its 65th birthday.

Nautical computer

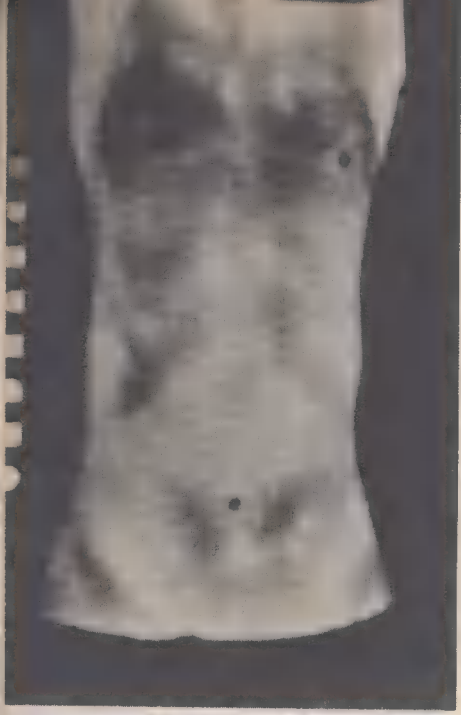
A sea-going computer is doing yeoman service aboard a Scripps Institution of Oceanography research vessel. Installation of the IBM-1800 data and control system is part of a joint research project conducted by Scripps and IBM. The computer is being used

IBM 1800 makes history as first of its kind to be installed on research ship.

to control complex scientific and industrial processes, ranging from glass production and oil refining to drug research and air-pollution testing.

Dr. William A. Nierenberg, director of the University of California, San Diego's Scripps Institution of Oceanography, believes the computer will give the scientist a tool with which to achieve information more rapidly at sea. He said scientists at sea would prefer to have immediate analyses of their research while the ship still is in its area of operation in order to confirm their findings before moving on to a new work station.

The computer will do regular routine logging of the marine environment, including measuring water depth, checking sea-surface temperatures and salinity, calculate wind speed and direction and take air temperature and humidity measurements; collect data for specific scientific experiments.



TECHNOLOGY

The infrared camera records the heat differences between a non-pregnant woman (above) and a pregnant woman (below). The site of the placenta is shown by the light grey (warm) area of the abdomen. Infrared techniques avoid the use of X-rays, thus eliminating a potential radiation hazard to infant and mother alike.

SCIENCE DIGEST SPECIAL

INFRARED:

lighting up the invisible

From medicine to space photography, the impact of the newly developing infrared technology is making itself felt. It may save you money or even save your life by illuminating the unseen, and doing it cheaply and easily. One thing is sure, you'll be hearing more about infrared in the future.

Science Digest—November, 1967

by James R. Berry

At the Mount Wilson astronomical observatory, an astronomer takes a series of photographs of Mars. After studying the spectral lines he has caught on film, he announces that the Martian atmosphere is much rarer than believed. Space officials consequently scrap plans for landing instruments on the planet by parachute, and revise countless other plans that depended on a heavy Martian atmosphere.

• At the American Car & Foundry Company in Saint Charles, Missouri, engineers aim a camera at an insulated tank car. When the film is developed, specialists immediately spot areas in the tank's body where imperfect insulation led to a large and costly heat loss.

• A woman sits quietly in a room at Philadelphia's Albert Einstein Medical Center as a bulky apparatus hums a few feet away. Later, doctors examine a photograph produced by the instrument and pronounce the woman free of a suspected breast cancer.

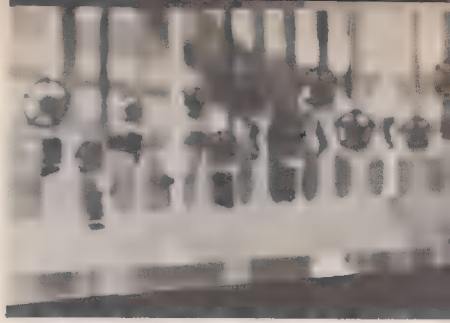
• Circling 700 miles above earth, the Nimbus II weather satellite snaps pictures of the earth's nighttime side. When the photographs are radioed to earth a few minutes later, meteorologists are alerted to a budding hurricane in the area.

These four incidents, and scores more like them, are due to an increasingly valuable technology that has grown around infrared light—radiation similar to light waves but invisible to the human eye. Just ten years ago, this technology was an infant science with few achievements to its credit. Today, it has blossomed into an invaluable scientific tool that is performing such far-reaching tasks as detecting camp fires of enemy troops to indicating faulty spots in electrical transformers; from warning jet planes of deadly clear air turbulence ahead to substituting for X rays in many kinds of medical diagnoses.

While the importance of infrared technology has cascaded only recently, the phenomenon of infrared radiation has been known for almost 170 years. In 1800, the English astronomer Sir William Herschel studied the sun through various colored filters in an effort to improve observation techniques. "What appeared remarkable," he wrote, "was that when I used some of the [filters] I felt a sensation of heat, though I had but little light. While others gave me much light with scarce any sensation of heat."

Curious, Herschel used a prism to break up the sun's light into a spectrum. In what is now a famous experiment, Herschel measured the colors of this spectrum, from blue to red, with a thermometer. The bands of light, he found, became progressively warmer, the red band being warmest of all. Then he stuck his thermometer beyond the visible red streak into an area where, apparently, no light existed. To Herschel's amazement, the temperature rose still higher. He had discovered a new type of light, one the human eye couldn't see. From other

Infrared portrait, at right, of valve system, above, shows hot spots detected by periodic checkups. Infrared cameras spot differences as small as one degree centigrade. White areas denote excessively hot pipes which usually precede a breakdown.



A few years ago this flash tank manifold system undoubtedly would break down before engineers realized trouble was developing. Today thermal maps detect hot spots where deviations from the norm exist and the problem is quickly remedied.

experiments, Herschel found that this radiation obeyed the same optical laws of reflection and refraction as visible light, and was produced by any hot object. He called this band infrared, from the Latin word "infra," meaning below.

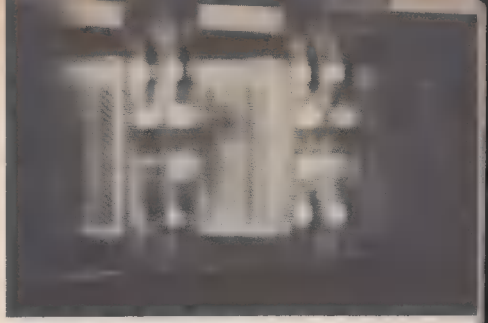
Herschel's discovery was important to physicists. But uses of infrared light as a technological tool didn't really get underway until well after World War II. And, among the first dramatic applications of the technology—in the field of medicine—began with an unsensational medical report.

In 1961, three British doctors published a study showing that breast cancers were slightly warmer than normal tissue. Among the specialists who read the British report was Dr. Jacob Gershon-Cohen, then chief of radiology at Philadelphia's Einstein Medical Center, who said, "Here we were trying to find breast cancer with highly sophisticated, expensive X rays and the British come up with a way that used a cheap, primitive temperature gadget."

Interested in probing the possibility of using temperature as a cancer indicator, Gershon-Cohen asked Dr. Bowling Barnes—acknowledged as among the world's foremost infrared scientists—if he could develop a camera that would make a sensitive infrared portrait of a patient. Within six months, Barnes delivered the first medical infrared camera, known as a thermograph, allowing Dr. Gershon-Cohen to use infrared energy radiated by healthy and abnormal tissue as a gauge of temperature.

In February, 1967, Gershon-Cohen reported on 3500 women patients examined for breast cancer by the thermograph. After checking out the infrared portraits—called thermograms—with other diagnostic techniques including X rays and biopsy, he found that 95 percent of all breast cancers had a temperature rise of at least one degree centigrade higher than normal tissue, proving the instrument's value as a medical tool. Today, a dozen or so hospitals across the country employ thermograms as a means of diagnosing breast and other cancers.

Infrared portraits indicate problem with overheating brushes in generator. Pictured above is generator as seen by the eye. With infrared camera, right, white areas show overheating. At top of photo grey band is used to determine temperature.



Thermogram shows generator brush temperature differences up to 10° C. Automatically-generated reference strip at top of thermogram permits direct reading of temperature based on greyness. White squares show the hottest brushes, at about 72° C.

But the thermograph's use extends beyond cancer diagnosis. Infection, fractures, bruises, abscesses and other maladies are surrounded by more body fluids, including both blood and lymph. The greater accumulation of these fluids increases the amount of heat in the area, which a thermogram easily spots. X rays, which pass through soft tissue, often fail to record such ailments.

In one case, a truck driver complaining of an injured back due to a job accident was referred to Gershon-Cohen. X rays revealed nothing unusual, and because the injury involved compensation the man was classified as a malingerer. Gershon-Cohen prescribed a thermogram, which pinpointed a hot spot near the base of the man's spine. "Well, you can't malinger a hot back," exclaimed Gershon-Cohen, "so our orthopedic surgeon went to work on him and found a ruptured disc." The man received compensation—plus adequate treatment.

Even the lack of heat can lead to an important medical diagnosis. Re-

Infrared picture of insulated tank car will show location of heat leaks. The car was filled with hot water, left standing on track for a day, then photographed. The white spots in second thermogram below show hot points indicating heat leaks.

cently, a 58-year-old woman with a recent history of dizzyness entered New York's Columbia Presbyterian Medical Center. After a routine examination, Dr. Ernest Wood asked for a thermogram of the patient's face. Seconds after examining the picture, he knew what was wrong. A patch on the left side of the woman's forehead was a degree or so cooler than the other side, indicating a partially blocked head artery that caused periodic dizzyness and indicated the strong possibility of a future stroke. With this information in hand, Dr. Wood began a series of treatments designed to avert such a calamity.

Thermograms in Arctic

Infrared heat portraits are making important contributions to medical research as well as diagnosis. At the Arctic Aeromedical Laboratory in Alaska, medical specialists used thermograms to study the heat loss in arctic clothing—the first practical method of testing new designs under field conditions. Fully clothed subjects stood in temperatures as low as −35 degrees centigrade for ten minutes; then a thermogram was made of each one. When the tests were made for the first time, in 1962, a shiver sped through arctic specialists.

Heat loss from hands and feet was much higher than expected, showing that arctic gloves and shoes were not very efficient. Heat loss soared where clothing wrinkled, which compressed the insulation or layer of trapped air inside the garment. Zippers were another problem. Body heat easily escaped from the thin metal, which was hard to insulate properly. Arctic studies confirmed what most people already realized. In cold weather, the bare head acts as a wick that allows huge quantities of body heat to evaporate into the air. Since infrared studies of arctic clothing began, effectiveness of gloves, hoods, boots, and other cold weather garments has risen steadily.

Astronomy is another field getting a boost from infrared technology. At Mount Wilson Observatory, California, researchers measured the amount and frequencies of infrared radiation passing from Mars, through its atmosphere, to earth. Since carbon dioxide absorbs infrared at a known rate, astronomers learned how much of the gas was in the Martian atmosphere. In turn, this indicated the atmospheric pressure of the planet—which turned out to be .37 pounds per square inch, much lower than previously believed.

But not all infrared studies of the heavens are so conclusive. During 1962, Drs. Bruce Murray and James Westphal zeroed in on the planet Jupiter's infrared radiation for study. During one of scores of observations, the two astronomers scanned a region darkened by the shadow of one of the planet's large moons. Normally a shadowed area, being cooler, would emit less infrared radiation. Instead, the amount of infrared energy given off under

Infrared technology important tool in medicine, outer space exploration, and forecasting mechanical problems.

the moon's shadow jumped by 30 times. The incident, which has never repeated itself, has astronomers baffled. Perhaps the puzzle will be answered when fly-by probes examine specific areas of the planet with infrared detectors and radio their findings back to earth.

While infrared technology is helping to explore other planets, it is also focusing on earth itself. The weather satellite Nimbus II, launched in May, 1966, is still forwarding reams of weather data daily. When orbiting over sunlit portions of earth, Nimbus II takes photos in the visible portion of the light spectrum. Over darkened areas, it switches to infrared, reporting on weather conditions in nighttime areas.

But besides locating and tracking storms, Nimbus II's infrared cameras are transmitting other vital meteorological information, including measurements of the earth's heat balance—how much of the sun's heat the earth receives, how much it reflects back into space—water vapor absorption at various altitudes during different seasons, stratospheric temperatures, and heat radiation of different land masses such as mountain ranges or deltas.

While Nimbus II's primary assignment is gathering weather data, its infrared pictures have proved a bonus to other fields. In August, 1966, a recently formed volcanic island off the coast of Iceland erupted anew. By chance, Nimbus II orbited over the island the day after the eruption and got infrared portraits of the event. From these photos, plus aerial infrared pictures, U.S. Geological Survey scientists were able to study the underground concentration of lava, how it flowed, and other geological information about volcanic formation, data that will hopefully aid in predicting future eruptions.

In another instance, oceanographers studying some infrared portraits of the Atlantic Ocean identified a dark streak meandering down the water's eastern end as the Gulf Stream, an important current about 10 degrees warmer than surrounding water. Because the Gulf Stream wanders several miles to one side or the other every few days, a ship or airplane would need days of reconnoitering to monitor the seasonal boundaries of the current. Nimbus II snaps infrared pictures of the entire Gulf Stream within minutes, handing oceanographers an accurate, efficient way of plotting the current's major pathways and habits, information of major value to fishing experts and weathermen.

But Nimbus II's handiwork is just the beginning. Now planned is EROS (Earth Resources Orbiting Satellite), orbiting hardware that will locate and monitor the earth's resources, both natural and created.

Among these resources: timberland and crops.

Healthy plant life is a good reflector of infrared light. Sick or dying plants or trees aren't. The degree of infrared reflection, therefore, indicates the state of vegetable life. "It's now possible to survey forests or orchards from the air and pick out trees that are losing their vigor three years before their diseased condition would become obvious to a ground observer," states Dr. Robert Colwell, professor of forestry at the University of California. "Specialists can even distinguish between diseased wheat and diseased oats from infrared photographs taken as high as 10,000 feet." Presently, Dr. Colwell is taking a portfolio of infrared photographs of forests, ore deposits, mountains, lakes, and other earth resources to use as comparison standards when analyzing future infrared photographs relayed from EROS and other satellites. Still other reports EROS is expected to telemeter to earth: sources of fresh water, movement of glaciers, air and water pollution, rates of reservoir sedimentation, the growth levels of deltas, and the location of precious ores and metals.

Industry is another area where infrared technology is rapidly being turned into a vital workhorse. By checking the amount of infrared light radiated by sheet steel during processing, quality control engineers can keep specified thickness to within hundredths of an inch. Foundry engineers use infrared sensors to measure temperatures of two or more metals before blending them into an alloy. Even a slightly imperfect temperature of any one metal can result in a substandard alloy. And, airlines are now perfecting long-range infrared detectors that spot air currents by their temperature differences. Two wildly varying readings indicate currents ahead that cause violent winds that have ripped planes apart. So far, only infrared detectors have been able to note such clear air turbulence.

Infrared spots trouble

Yet another industrial use of infrared is in generating plants where periodic checks are often made to spot substandard performance or warn of impending trouble. Not long ago, the Wisconsin Electric Power Company in Milwaukee took infrared portraits of its substations. In one generator, infrared pictures spotted a 10 degree centigrade variation among 16 brushes, all supposed to be carrying the same load. Power station operators traced the trouble spot to variations in spring pressure on the brushes. In another plant, infrared portraits pinpointed a power switch where the temperature soared 30 degrees centigrade above similar equipment. At full operating load, a faulty switch could have plunged sections of the city into darkness. Engineers found that contaminants between the blade of the switch and the clip it entered caused the problem.

The electronics industry is another field where infrared diagnosis is becoming steadily more impor-

Infrared camera photographs—thermograms—aid in detecting cancer and other ailments where X rays fail.

tant. "Because of the trend toward miniaturization, the problem of heat dissipation is constantly more severe," states Robert Horne, aircraft development engineer of Lockheed Aircraft Corporation. "Unless a transistor or resistor of greater load capability is substituted for overheating elements, an essential aircraft system can fail with costly results."

In one case, Lockheed used infrared portraits of electronic circuitry to find a trouble spot in the power supply control module of the C-141 transport plane's ailerons. The temperature of the power transistors was fine. But the infrared picture showed that every resistor was running too hot under maximum load. Design engineers dispersed the resistors and increased their rating. Running temperatures dropped to within specifications.

Often, infrared technology saves weeks of time and thousands of dollars in industrial development costs. At the Sikorsky Aircraft Division of United Aircraft, engineers evaluated each design of a de-icing element for the air intakes of an assault helicopter by snapping infrared pictures of the item while it was undergoing tests in a variable-weather wind tunnel. Within minutes they had a portrait showing where heat flow was uneven under given weather conditions. As a result of the quick diagnosis of each de-icer design—which only infrared methods provided—weeks of time were sliced from the expected time needed to determine the best combination of materials and configuration for the element.

Infrared technology is even zeroing in on the microscopic. Electronically checking miniature circuits reveals broken connections, but not all faulty ones that are due to break under vibration and stress. Now, important miniature components such as an integrated circuit can be examined under an infrared microscope developed by the Barnes Engineering Company.

One side of a component is heated slightly. The other side is cooled. Heat flows evenly across the item until it hits a poorly made connection. At this spot, heat dams up like water in a reservoir. The microscope, which can focus on a spot one-thousandth of an inch in diameter, measures the temperature difference of adjoining areas as the operator scans the component. If it runs over a hot spot, a meter records the variation.

While infrared technology has already made its mark in dozens of ways, its usefulness is just beginning to pick up speed. Practically every month sees new developments in the field, promising yet other ways that infrared technology will help researchers uncover nature's secrets.

(Continued on page 50)

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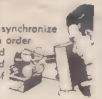
A Neon Lamp that flashes at intervals you can synchronize with the speed of rotating or vibrating objects in order to "freeze" their motion to permit close study and checking frequencies and RPM. Flashes are timed by a variable frequency oscillator with a range of 20 to 600 cycles per second.



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Electronic Computer multiplies, divides, calculates powers, roots. Set up the problem on the scales of two potentiometers and find the answer on the scale of third potentiometer as indicated by a sensitive meter. Instruction Manual covers computer theory and practical use. Over 150 sample problems and answers demonstrate use with fractions, trigonometry, logarithms, physics formulas, ballistics, etc.

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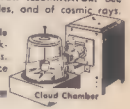
ATOMIC ENERGY LAB

ATOMIC CLOUD CHAMBER WITH PROJECTOR ILLUMINATOR. See the vapor trails of alpha and beta particles, and of cosmic rays. **SPINTHARISCOPE.** Shows exploding atoms. **ELECTROSCOPE** — metal housed with **Scale** and **Magnifying Viewer.** Measures background radiation and tests sample sources. **SAFE RADIOACTIVE MATERIALS.** Alpha Source in handy container and Uranium Ore. **Full instructions and explanations open the fascinating field of nuclear physics.**



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30X erect image. Extends to 30" length. Five

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The $1 membership fee covers a year's subscription to the ABSClub Bulletin which carries news of interest to members, plus ideas submitted by members for additional projects with the kits.

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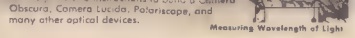

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Q. How is it possible? It seems incredible to be able to get all the equipment shown above in just nine kits — at only $4.75 per kit!

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Q. May members choose the order in which they receive their kits?

A. Yes. With the first kit members receive a list of the equipment and projects contained in each of the remaining eight kits. With this information they are able to choose the kit sequence that best suits their particular interest.

Q. Can members get their kits all at once instead of one-a-month?

A. Yes. At any time members can have the balance of their kits sent in one shipment. We recommend that you start on the kit-a-month plan because the monthly spacing will give you time to get the full measure of knowledge and enjoyment that each kit has to offer.

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Infrared detectors

Although the greatest advances in infrared technology have come within the last decade or so, the first of a long series of infrared detectors was born over 100 years ago. This was the thermocouple, which consisted of two dissimilar metals that, when heated, generate a measurable electrical current. An English astronomer named William Parsons joined several thermocouples together in series to make a more sensitive instrument called a thermopile. He used a thermopile to measure the infrared radiation of the full moon. Later, the thermopile was placed in a vacuum, which by eliminating variations in air temperature, increased the instrument's sensitivity.

In 1880, an ingenious detector called the bolometer was invented. This device was a blackened metal foil to absorb infrared radiation. As the foil heated up, its resistance to an electrical current increased proportionately. Measuring the foil's change in resistance with a voltmeter indicated temperature. The bolometer, while primitive at the time, allowed astronomers to make crude measurements of the sun and moon's infrared energy.

The next advancement in infrared detectors came in 1942 when the slight expansion of a confined gas measured heat. The increased gas pressure distorts a mirror. In turn, this causes a light beam glancing off the mirror to move. The position of the light beam indicates the amount of infrared radiation striking the gas. The instrument, is called the Golay cell.

Other infrared detectors growing out of solid state physics depend on photoconductive effects, wherein the conductivity of a material changes depending on the amount of radiation received. Photoconductive detectors—since they measure infrared radiation directly, not the subsequent heat rise—have to be kept cold while in operation to avoid contamination from infrared radiation.

The thermograph—the infrared camera developed by the Barnes Engineering Company—doesn't take its pictures directly on infrared-sensitive film. Reason: the film would have to be very sensitive to capture far infrared radiation and would therefore be fogged by the infrared light emitted by the camera.

The thermograph makes a heat portrait by scanning a scene with an infrared detector, focusing on one small spot at a time. The infrared radiation detected is converted to an electric current which modulates a pinpoint beam of light. This light beam scans across a sheet of Polaroid film something like an electron beam sweeps across a TV screen and gradually builds up an infrared portrait of the subject.

Significance of infrared developments to industry, business and professions

• *Agriculture*—Because thriving vegetation reflects infrared better than sick plants, diseased trees in forests and orchards—even grain—can be spotted by airborne sensors far in advance of earthbound visual inspection. Stricken plants can be culled.

• *Automotive*—In both research and quality control, infrared detectors already are locating "hot spots" in all forms of internal combustion engines. They'll be used for diagnosing engine ailments and for building more efficient systems.

• *Aviation*—There's little doubt that current experimental detectors will become standard on aircraft, to spot thermal currents, locate and warn pilots of sheer currents and clear air turbulence. In the lab, infrared already is spotting faulty de-icing.

• *Clothing*—More efficient winter and polar apparel will be possible by subjecting insulated garments to infrared inspection. Sensors spot points and degree of heat loss.

• *Electricity and electronics*—infrared trouble-shooting instruments are measuring heat differentials in generators, switches, circuits—pinpointing potential trouble before it happens. Same goes for transistorized circuitry; checking faulty connections, heat dissipation, etc.

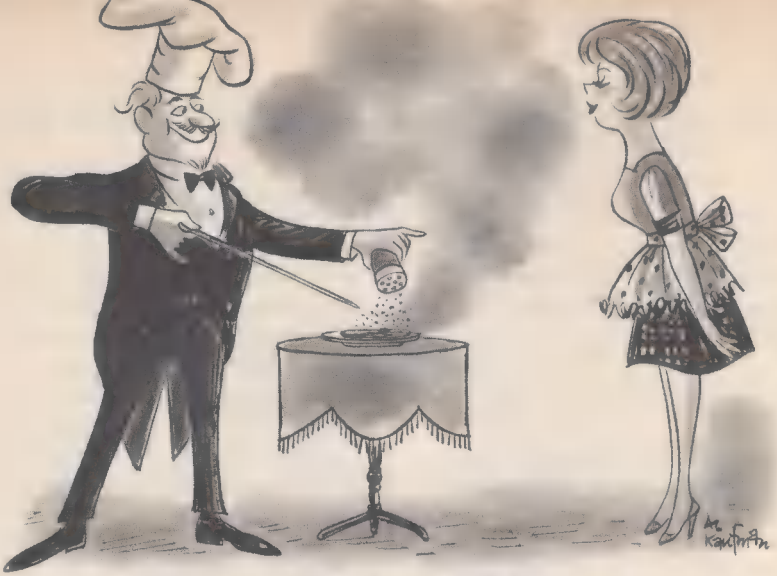
• *Medicine*—Simple infrared instruments will supplement intricate systems for locating internal cancerous tissue by temperature differential; already thermographs are diagnosing and pinpointing breast cancers, fractures, internal infections, and circulatory blockages.

• *Metal fabrication*—Sensors may spot and control temperatures of molten alloy components to insure a perfect mix. By measuring infrared radiation from sheet steel, thickness of the sheet can be controlled to within hundredths of an inch.

• *Military*—Airborne and ground sensors can detect body heat of enemy troops, locate vehicles, campfires. Devices hitched to guns spot individual soldiers in darkness.

• *Photography*—New applications of infrared will expand industrial and research photography to limitless horizons. In astronomy: sensors on telescope cameras measure density and make-up of planetary atmospheres; temperature of celestial bodies; locate bodies invisible to optical or radio telescopes. In meteorology: weather satellite infrared pictures spot incipient hurricanes and fronts and provide continuous storm tracking, day and night. In archaeology: Infrared may locate mounds, ruins and ancient roads hidden under vegetation.

• *Refrigeration*—Infrared heat loss studies will provide quality control and maintenance data for all forms of refrigeration from ships and boxcars to domestic refrigerators.



Chemicals that tickle your taste buds

THE claim that a processed food product is "Just like Mother used to make" has a strong appeal in an age when women simply do not have the time to prepare certain dishes. In 1940, the average housewife spent about five hours each day preparing three meals for her family of four; currently, these culinary tasks take her about 1½ hours. Mother-as-cook has, in part, been replaced by the manufacturers of "convenience foods." These convenience foods are often easier to carry home or to store, some of them can be cooked in the package, and the premeasured portions result in fewer leftovers.

But while many of the convenience dishes may resemble those Mother made, few of them are as savory—a fact which food processors admit among themselves. Not uncommonly, that *bete noire* of gourmets, "artificial flavoring," is responsible for this sad truth. But the aspect Mother loves most about convenience foods, that they were partially prepared long before she fired up the stove, also contributes to a loss of flavor—no matter how you spice it, there appears to be no substitute for freshness.

Yet even the blandest foods are not without some flavor, and as U.S. food processors discovered during the 1940s, it is possible to accentuate some of these residual flavors by adding substances known as flavor potentiators. Monosodium glutamate, or MSG, was the first, and for many years the only, potentiator on the market, but today

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processors have several of these food additives from which to choose.

Dried seaweed

MSG was discovered in 1908 by a Japanese researcher seeking to explain why adding a bit of dried seaweed seemed to enhance the natural flavor of many foods, and particularly those high in protein. From an extract of the marine plant, sea tangle, he was able to isolate a white crystalline powder which, when sprinkled sparingly on food, added no flavor notes of its own yet somehow amplified or enhanced certain naturally occurring flavors. Shortly thereafter, MSG in its pure form became available in Japanese foodshops. Not until World War II, however, when spices were scarce and food processors were searching for new ways to add zest to their products, did MSG find much of a market in this country. Since then, the popularity of this flavor potentiator has grown steadily. In dollar value, the MSG consumed in the U.S. each year now outstrips every condiment and flavoring agent, with the possible exception of salt. But to the present day, no one has been able to establish conclusively just how the substance affects our taste buds.

Actually, the question of what MSG does to specific flavor notes has created nearly as much disagreement among researchers as the question of how it makes the subtle changes. Indeed, until recently, there was little agreement on what to name these substances; were they seasonings, flavoring agents, flavor enhancers, or what? But in 1964, the Arthur D. Little Corporation sponsored a flavor symposium at which they suggested that MSG, and other chemicals with similar action be considered "potentiators." The word was lifted from the vocabulary of pharmacology, where potentiation describes a synergistic reaction—in which small amounts of a chemical may exaggerate the effect of one or more other chemicals taken at the same time. Generally, it seems that the magic performed by MSG on the taste buds is essentially synergistic in nature. Regardless of how an original or an altered taste may be characterized by judges, sprinkling MSG on meat produces a meatier taste, and adding it to sauce promotes a saucier taste.

"Satisfaction"

The appeal of one recipe for, say, corned beef hash over another depends on more than taste alone, however. Food processors, who account for most of the MSG used in the U.S., early realized that aroma, and a feeling defined as "satisfaction" after eating, also play an important role in consumer acceptance of their products. Adding MSG appears to increase the aroma and satisfaction appeal of many foods.

In attempting to understand what is meant by satisfaction, and

MSG and IMP bring out flavors, but trial-and-error is guide to correct use.

food technologists do not mean the appeasement of appetite, one may choose between such descriptions as "a tingling feeling," a "persistance of taste sensations," an "agreeable afterimage in the buccal cavity," or to return unrewarded to the problem, "a feeling of satisfaction." The effect of MSG on aroma is truly baffling. It appears to reduce "sulfury aromatics" in meat, but may accentuate the sulfur level in mustard to an intolerable extent. Adding MSG to fresh fish may make the aroma more agreeably fishy, whereas the aroma of fish that is less than fresh may be pushed to a point where it is unacceptable.

In the absence of almost any applicable information about MSG, food processors are left to their own trial-and-error methods in using the substance. In 1962, a second potentiator was put at their disposal, about which only slightly more is known. The new product is marketed under the trade name "Mertaste," and is a mixture of two related potentiators—disodium inosinate and disodium guanylate. As with MSG, disodium inosinate was discovered many years ago by a Japanese researcher. But only recently has it been possible to isolate the chemical, known as IMP, in great enough quantities to make it available to processors. IMP, too, was originally derived from sea tangle, but it can also be extracted from dried bonito (a name applied to many species of fish related to mackerel). Disodium guanylate, or GMP, is isolated as a by-product of IMP production.

Recent entry

Thus far, Mertaste is available only to food processors. Although a recent entry in the market, it seems safe to assume that it will soon be incorporated in many products—its effect is even more remarkable than that of MSG. For example, Mertaste enhances meaty and brothy tastes as does MSG, but in addition it also enhances the MSG effect. As a result, a food processor who used to add 100 pounds of MSG can now get by with only 10 or 15 pounds of a MSG-Mertaste mixture—without altering the flavor of his product.

In addition to enhancing always meaty and brothy flavors, they also enhance buttery and sweet flavor notes in some foods. On the other side of the coin, these new additions always suppress such notes as HVP, or "hydrolyzed vegetable protein" (usually strong in bouillon cubes), and sulfury, or "burnt cabbage." In some foods, the following flavors may also be suppressed: sour, fatty and oily, starchy, burnt, and even herb-spice complexes. So the potentiators must be used with caution, or the final product may have less of the desired flavor than if left un-

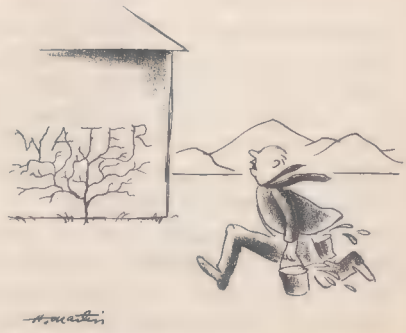
treated. Furthermore, there are many foods to which the chemicals should never be added. For example, when added to milk products, IMP introduces an extraneous brothy note. In other products, they alter the flavor in such a subtle way that, although the change is detectable, taste panels cannot decide whether the change is for the better or worse.

Viscosity illusion

Perhaps the most remarkable effect is that, when added to soup, for example, they create an illusion of viscosity in the mouth. As far as the flavor potentiating effects in soup are concerned, Mertaste is most effective in quantities between 50 and 200 parts per million. And when added in these quantities, the viscosity of the soup is not measurably altered. Yet the impression, when the soup is swallowed, is one of great body or fullness. Consider, again using a dried soup mix as an example, what the over-all effect might be of adding a small amount of the nucleotides. The dehydrated or "hydrolyzed" flavor would be suppressed, the brothy flavor enhanced, and the illusion of richness and body added—a combination of characteristics welcomed by soup lovers for whom the long simmering pot is a thing of the past. Even Rover seems to find meat-flavored dog foods more palatable when a dash of flavor potentiators have been added.

To round out the flavor potentiator picture, as it now stands, some mention should be made of the newest member of this group, a chemical known as maltol. Added to beverages such as fruit drinks and sodas, it allows a 15 percent reduction of sugar without any appreciable decrease in sweetness. Further maltol is said to make artificial fruit flavors a bit fruitier, to enhance the chocolate and vanilla flavor and aroma in baked goods, and to suppress the acidity and aftertaste of catsup. Even such dissimilar items as perfumes, paint, tobacco, bitter drugs, inks, insecticides, lobster, paper and wine, have all had their flavor, aroma, or both, improved by a judicious addition of the chemical.

From all reports, chemists expect to find still more substances with which to impart new or altered flavors and consistencies to our food. The Greek playwright, Aristophanes, once questioned whether "victuals and drink" were perhaps an illusion of the senses. His question seems increasingly pertinent.

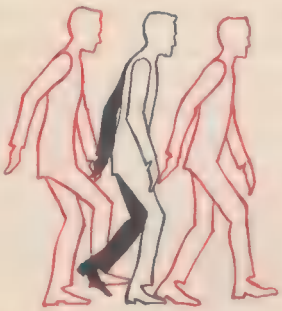


"I'm coming! I'm coming!"

Step to catastrophe

by Arthur J. Snider

MAN has been walking for millions of years but each step is a potential catastrophe. A step thrusts the body from a state of balanced equilibrium to fleeting instability. Only the action of the muscles keeps the walker from falling on his face. In other words, walking is one controlled fall after another.



Some walkers live more dangerously than others. Dr. Philip Brachman, professor and chairman of orthopedics at the Illinois College of Podiatry, says the degree to which one moves from stability to instability and back again varies from individual to individual.

People have their own distinct walk patterns because of hip-thigh musculature and anatomical mechanics of the pelvis. The female pelvis, for example, retards the range through which the hip can move forward or back. Women are obliged to rotate the pelvis through a greater angle than do men. The resulting wiggle is not lost upon girl watchers.

There also is a difference in the way people place their feet in touching the ground. It has been believed that toes pointed straight ahead was the only proper way to walk, presumably because the light-footed Indians walked that way.

"It has never been proven that all Indians walk that way," says Dr. Brachman, author of a new textbook on foot orthopedics. "If they did, it has never been proven they were free of locomotion difficulties. Some people seem to walk in an awkward manner, with toes in or toes out, but if the position is comfortable for them, then it is normal."

In addition to a rolling motion, walking involves up-and-down and side-to-side displacements. An army marches in unison for more than discipline and smartness. When two people walk together with opposite feet leading they will sway first toward one another, then away, occasionally bumping.

The up and down motion is evident in the bobbing of heads.

While walking is taken for granted, it is a complicated process. It begins with the body pitching

slightly but precariously forward. One leg quickly swings through and makes contact with the ground so that the center of body weight is again safely between the two legs. Then the rear leg starts through, pushing off against the ground, first with the ball of the foot and then the big toe. Before making contact with the ground again, the leg straightens at the knee but remains bent at the ankle. Thus the heel strikes the ground first.

In a complete walk cycle—from heel strike to heel strike of the same leg—both feet are on the ground for about 25 percent of the time, as computed by John Napier, anatomist at the University of London.

The faster one walks, the less work the foot must do, Brachman points out. As the gait slows down, the forepart of the foot takes the greater brunt of the weight. This may account in part for the increase in foot problems of the elderly.

Primates other than man also walk on two limbs but only modern man has perfected the art. It required extensive evolutionary change. The hind legs had to grow longer, the pelvis broader and shorter, the trunk more stable. The foot also needed considerable reshaping.

A significant change occurred in the muscles of the thighs and buttocks which are powerfully developed in man but weakly developed in monkeys and apes. This is especially important in walking up a steep slope or climbing stairs. It prevents the human trunk from jackknifing on the legs.

Why did walking evolve? Anthropologists say it primarily was an adaptation for covering long distances economically, particulary so after man became a hunter. Bipedalism freed the hands so food could be readily carried from one place to another without having to be consumed on the spot.

Man's most immediate hominid ancestor, the *Australopithecus,* was bipedal but an inefficient walker, Napier says in *Scientific American.* He covered the ground with quick, short steps, knees and hips bent, and required a high output of energy that limited long-distance travel.

Only in the last six years has the fossil evidence been found by L.S.B. Leaky of a more advanced hominid —the homo habilis—possibly the earliest known species of man. It has a foot closely resembling the foot of modern man, particularly the big toe, which is a key to the striding gait.

We won't live longer

In the matter of extending longevity, medicine has just about had it, in the belief of Dr. William H. Forbes of the Harvard School of Public Health.

Regardless of how much money is to be spent, the magic yet to be pulled out of medicine's hat won't have much more effect on the average life span, he says.

In each decade during the first half of this century, the gain in

longevity was almost 4 years for man and 4.5 years for women. But since 1950, the total cumulative increase has been 1.6 for men and 2 for women.

In the last available decade (1954-1964) the gain has been a negligible 77 days for men and 365 days for women.

Even as longevity fades, medical care expenditures have risen to become the third largest industry. In the last 17 years, the outlay has jumped from $13 billion to $44 billion.

While agreeing that it is going to cost more and more to get less and less, a University of Illinois professor of preventive medicine and community health asserts that potential advances still are worth going after.

"If cancer becomes a curable disease in persons over 50, it would add a year to the average longevity," said Dr. Mark Lepper. "If half of coronary attacks could be prevented, another year would be added."

Longevity, he stressed, is only one measure of a nation's health. Equally important is the quality of individual function.

"If we knew all there was to know about preventing disease and could say that everyone would simply wear out and collapse like the one-horse shay at age 110 or 120, how many would prefer to go that way?" Lepper asked.

"How many would prefer to know they would live to a predictable biological endpoint accompanied by senility or other disability and how many would prefer to die in stages, a little at a time, but remain functional?"

With an average of 66.9 years of life expectancy at birth, the U.S. ranks 21st among advanced nations in the longevity standings. The Netherlands leads with 71.4 years.

Dr. Forbes says in the *New England Journal of Medicine* that medicine is not to blame for the diminishing returns on health investment. In fact, the profession has done its work so well in attacking all the medical factors affecting longevity, there are few worlds left to conquer.

Gains now can come only through social and cultural factors that impinge on health, he asserts. For example, auto accidents accounting for 2.6 percent of all deaths, are not primarily medical problems but human attitudes toward design of roadways, design of cars, drinking, speeding and courtesy on the road.

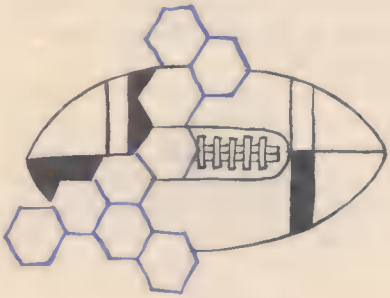
Similarly, preventing cancer of the lung lies primarily in sociology —in convincing people to stop smoking—rather than in medicine.

Football players' fads

Food fads top the list of superstitions among professional football players.

"There are some pros who before a football game will eat a great deal of honey, maybe half a jar," says Dr. James A. Nicholas, medical trainer of the New York Jets. "By half time they will throw it up.

"They have been taught by someone that building up carbohydrate before a game is where you get your energy. There are others who think a high protein diet is great. So in the pre-game meal they'll eat three steaks.



"These are idiosyncracies. There is no evidence that extra carbohydrates or proteins will make a man stronger. A good breakfast is important, however."

Dr. Nicholas says another fallacy is the belief that it is bad for a football player to swim.

"Swimming is one of the best ways to develop certain groups of muscles," he advises. "One can get oversized pectoral (chest) and deltoid (shoulder) muscles. But that doesn't make swimming bad. It means simply that other muscles must be built up in proportion to these groups of muscles. At our training camp we allowed all our boys to swim. It hasn't hurt them at all. Indeed many boys with tight hamstrings, tight heel cords and tight thigh muscles get into the water to stretch. If an injured player needs to get back in shape in a hurry, one of the best exercises is a goose-step in waist-high water."

Stretching by calisthenics, Dr. Nicholas believes, is the most important factor in training. It permits getting rid of contractions in the calf and thigh. These are the common cause of injury in football camps.

"If you are not stretched, you put more load on the joints," he explains. "If you have more load on the joints it takes less force to hurt them."

Other idiosyncracies include gulping vitamins and tonics. One well-known college in the east gives its players B-12 shots, he says, but there is no evidence that they help.

"Of course, in two-a-day workouts, when athletes may use up 5,000 to 6,000 calories, augmented vitamins are helpful for that short period, but that's about it," Dr. Nicholas adds.

Another group of superstitions has been built around related "ergogenic aids"—oxygen, tonics, pep pills and hypnosis, but Dr. Nicholas says there is no aid to work output other than conditioning and hard work.

The dangerous "rush"

Amphetamine, the drug commonly found in nasal inhalers and swallowed in tablet form as "pep pills", is becoming a serious hazard as a result of the new practice of injecting the substance, California physicians warn.

The user gets a sudden, over-

whelming feeling called a "flash" or a "rush". He has an intense fascination with all his thoughts and activities. He has a tendency to gather with other users, talk incessantly, depart, seek more drugs and reunite in a group again.

Appetite for food is suppressed completely. There is no desire for sleep. Users may stay awake for days at a time and become more paranoid and disorganized, suffer a variety of illusions and hallucinations and then lapse into a long, long sleep. On awakening, they start another "run" with the drugs.

Dr. John C. Kramer and Dr. Don C. Littlefield of Corona, Cal., estimated there may be 4,000 persons in the San Francisco area alone who take injections of amphetamines into the veins.

They predict an increase in crimes of violence as a result of mental changes brought on by the drug. The addicts frequently feel that strangers are watching them, that their best friends have turned informers, that their apartments are "bugged" by the police department. They feel that trees and shadows in the streets are disguised detectives.

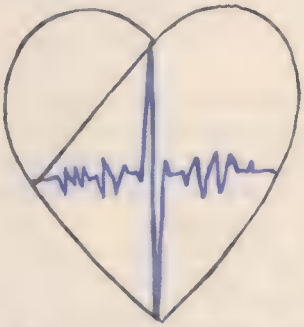
At times their paranoid mental state sends them out to assault those they feel are accusing them.

Because a tolerance is built up, amphetamine injectors require increasingly larger and more frequent doses. As the dose increases so do the toxic symptoms. There may be a 20-to-30-pound weight loss and other signs of malnutrition, including abscesses, non-healing ulcers and brittle fingernails. Prolonged psychosis or brain damage appears to be an end result.

Four heart disease dangers

Four factors stand out as indicators of heart disease, a 13-year study at Albany Medical College shows. These are:

- High blood pressure. Middle-aged men whose reading is in the upper 25 percent have about twice the incidence of coronary heart disease as do men of the same age in the lowest quarter.



- High serum cholesterol level. The incidence of heart disease is about 94 per 1,000 men with a cholesterol level less than 198 milligrams per 100 milliliters of blood and 210 per 1000 in those with levels of 255 milligrams per 100.
- Obesity. Men of ideal weight or less had disease incidence of 97 per 1,000 population while those overweight by 18 percent or more had an incidence of 181 per 1,000.
- Cigarette smoking. The incidence rose from 89 per 1,000 for non-smokers to 155 per 1,000 in persons who are heavy smokers.

'Don't eat' works

Of all the dauntless ideas for combating obesity, the no-calorie diet is the most drastic. Starvation for up to three months has been tried, with mixed feelings over the results. Some doctors argue that while the patient may lose considerable weight, he will resume his old eating habits and gain the weight back in time.

Air Force Captains Robert M. Karns and John J. Van Dyke of George Air Force Base, California, don't agree. The physicians found that of 25 patients attempting the complete starvation program of zero calories for up to 84 days, 16 were "unequivocally successful" and 11 had no trouble continuing the weight loss on controlled diets.

One military man was dropped from the program because he was sneaking food on the side.

It's not in the mind

Writer's cramp, a spasm in the muscles of the hand and arm of young people who do a great deal of writing, has long been attributed to a psychiatric problem.

The theory is that the writers are emotionally two-sided—having a feeling of both love and hate for their work.

Now a nerve specialist says writer's cramp may be due in many cases to an organic condition, perhaps even a tumor. Dr. Harold Stevens of Washington, D.C., cites the case of a 50-year-old physician who had no symptoms other than writer's cramp for three months before he died of a brain tumor. Several similar instances have been reported, he finds.

In writer's cramp, also known as scrivener's palsy, patients are usually able to start writing but soon the first two fingers begin pinching the pencil firmly and then the others become stiff.

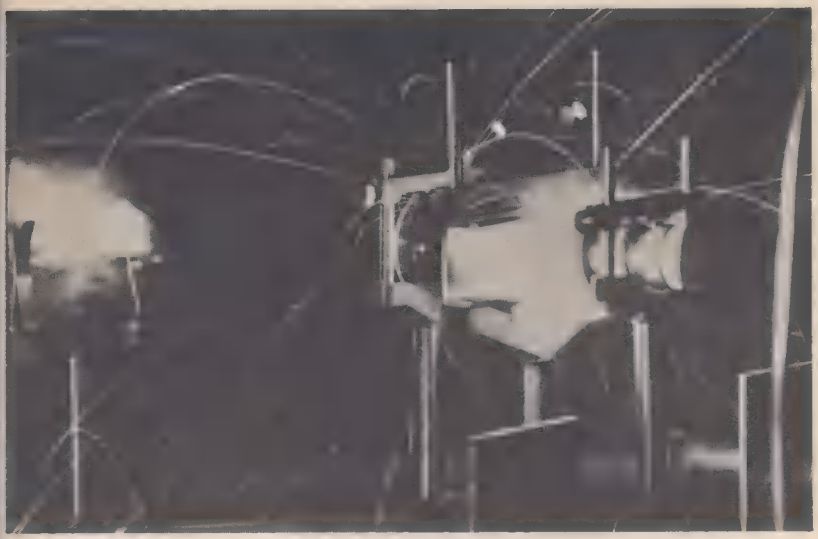
"The wrist inexorably flexes, the muscles of the hands and then the arm become taut and often painful," says Stevens. "Persistent attempts at continued writing, especially under observation, increases the cramp."

The fat that stays

Twenty years after they had been examined as obese children, 100 adults were again examined by the Public Health Service. Eighty-three were still obese, confirming the clinical impression, says Dr. Albert Stunkard of the University of Philadelphia, that fat children usually become fat adults.

Interviewing the 17 who achieved normal weight, Stunkard found that in four the weight loss "just happened" in connection with gain in height and physical activity. Most of the others undertook deliberate weight reduction for cosmetic reasons, largely as a response to teasing.

All had to continue watching their diet.



Dangers of the laser

by William J. Perkinson

LASERS are not an unlimited blessing. The powerful light beams, if indiscriminately used, can be highly dangerous. So dangerous, as a matter of fact, that in the opinion of experts, they could be developed into military weapons that can kill or seriously maim an enemy.

When the American Association for the Advancement of Science sponsored a symposium to alert the public to the dangers of the increasingly useful laser, the panelists noted that some of the powerful beams already in use for industrial and academic research as well as by the military and space sciences as range finders are capable of:

1. Causing serious eye damage to people who are struck by the invisible beam of light even though those people are more than a mile and a half away;

2. Blinding similar persons at distances of a mile or less, and;

3. Literally blowing a man's eye out of his head at distances under 50 yards.

Experts on the AAAS panel included: Dr. Samuel Fine, professor and chairman of the Department of Biophysics and Biomedical Engineering at Northeastern University, Boston; Dr. William T. Ham, Jr., professor and chairman of the De-

Magnitude of laser's power gleaned from one of the world's most powerful lasers, which blasts hole through quarter-inch steel girder. It's seven times more powerful than the laser that bounced a light ray from the earth to moon and back again. Comparatively weak burst of laser light can drill a hole through a block of mild steel.

miracle ray

partment of Biophysics at the Medical College of Virginia, Richmond; and Dr. Edmund Klein, chief of the Department of Dermatology at the Roswell Park Memorial Institute, in Buffalo, New York.

All three men stated, in answers to questions, that they themselves were not engaged in weapons research and that they knew nothing about such research. They all agreed, however, that in their opinion there seemed to be no scientific or engineering bars to developing such laser weapons.

The purpose of their panel, they said, was to bring to public attention some of the hazards of lasers that are now being built on a do-it-yourself basis by high school students and on a commerical basis by industry at a rate currently estimated at 10,000 lasers a year.

Dr. Ham said that all scientists and research workers know what happened to "the martyrs of the old X ray days." He added that few people realize how many injuries have occurred due to inexpert use of lasers.

Many of the injuries are not a matter of public record at this time, he said, because of the legal problems surrounding this new kind of injury.

Lasers, the three men stated, can be used beneficially for medical and other purposes like nuclear energy and electricity. Lasers also can be dangerous if used in other ways, they added.

In reporting on experiments with "Lasers in Biology and Biochemistry," Dr. Klein and Dr. Fine reported among other things:

"In our experiment when laser beams were directed at the forehead of mice from a distance of five or six inches at an energy of 50 joules per square centimeter, and a wavelength of 6943 angstrom, with a one centimeter spot size, there was only slight damage at the surface (of the forehead).

"Examination of the interior of

the skull, however, revealed hemorrhage throughout the brain, in the cerebrospinal fluid as well as within the substance of the brain.

"The mice either died immediately or experienced serious neurological defects. When glass was interposed between the beam and the animal, the damage was increased."

When the laser beam was focused on the backs of mice the beam "produced extensive skin damage and mild temporary paralysis. Permanent paralysis or death resulted when higher energy densities were used."

Another series of observations, Dr. Klein added, showed that:

"Severe injuries resulted when Swiss mice were exposed for five seconds to radiation from a carbon dioxide laser at a power level of 5 watts per square centimeter.

"The delayed effects included auto-amputation of the limb. These possible late effects require as much consideration as the acute effects."

He said other studies with lasers showed that when tumors are hit by laser beams, living cancer cells may be ejected from the target site at speeds approaching that of sound.

Dr. Klein said these studies suggest that living tumor cells struck by a laser beam "might just as easily be pushed into deeper tissue or even into the blood or lymph circulation, causing the tumor to spread faster."

Dr. Klein concluded his report by stating that still other studies have shown that some types of bacteria may survive the impact of the laser beam and either may be thrust through the skin or into deeper tissue to cause infections.

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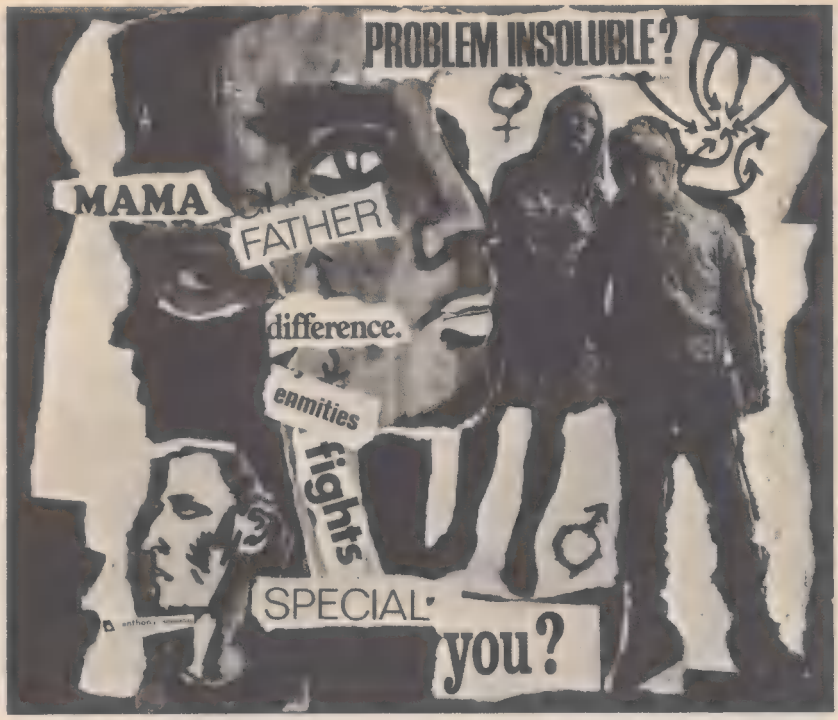

HOW TO DRIVE YOUR FAMILY CRAZY

by Flora Rheta Schreiber and Melvin Herman

LIKE it or not, each of us works in nefarious ways to drive our loved ones crazy. We can destroy each other by the way we act and the way we fail to act. We do this, too, through the atmosphere we create around us. When that atmosphere includes unreality and distortion, we are often setting the stage for mental illness.

Nobody wants to do this, but almost everybody does it to some extent. Perhaps it will help you to know how this is done and what are the deadly consequences. The methods—or shall we call them recipes—are legion. For convenience, however, we have selected seven that are tried and true and well-documented in the psychiatric literature. With a little imagination and initiative, you easily can add to our list.

None of the persons in these

stories is fictional. All are real. Only their names have been changed to maintain privacy.

Recipe one: How to lock your family in an emotional hothouse.

Twenty-nine-year-old Joe believes he shouldn't marry until he gets a better job, but he refuses to budge from the job he has. He constantly parades his plight before his family. With a flair for self-dramatization he bemoans his bad job and his inability to earn enough to have a home and a life of his own.

At the same time, however, Joe rationalizes his position. The job, he tells himself, except for a tyrannical boss, is not so bad. Isn't it secure? Secure, secure, secure, the word hammers in Joe's thoughts.

The hothouse, the emotional trap, the prison, call it what you like, is not originally of Joe's making. His parents drove him into playing this role. His mother, abandoning all hope of his father's advancement, settled for security. The father, trapped in a humble job, asserted that security is worth any price.

Forced into a "sick" role, Joe is too sick to see that he doesn't have real security with his boss. Unconsciously using that job as the symbol of parental protection and as the perfect setting for enacting the role his parents require of him, he is virtually a prisoner in an unhealthy family. To change, Joe must gamble, and he can't do it.

Joe enjoys exploiting his self-pity and the pity he receives from his parents. They confer special favors on him and make it possible for him to avoid responsibilities. They bribe him to repay him for the role of failure. The sick balance achieved is likely to be permanent, for Joe will never break the bond himself. "Most people," as Dr. Nathan Ackerman in his classic book *The Psychodynamics of Family Life* points out, "change only as the group changes with them." Before Joe can change, the family must change.

The Joes of the world are dangerous not only to themselves and to their immediate families, but to everyone their lives touch.

Recipe two: How to destroy the lives of your loved ones—and your own—by unreal demands.

Twenty-two-year-old Joan is the protagonist of this little drama. Beautiful but not dumb, she has almost everything—doting and intelligent parents; a loving fiancee. She takes everything her parents do for her—good schools to which they have sent her, the car they have bought her, the beautiful clothes they have lavished on her, the time they spend listening to her youthful worries; all these she takes for granted. What she wants is not within their power to deliver—an unreal, romantic dream world in which she is the fairy princess. She

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Miss Schreiber is an award-winning writer on psychiatry; Herman, the Executive Secretary of the National Association of Private Psychiatric Hospitals.

Joan thought Sam wasn't good enough for her and she told him so. But she was going to marry him anyway.

wants them to send her around the world, to provide her with Hattie Carnegie clothes, to say that she has the dancing talent of Pavlova, and to find her a prince whom she can marry. Even though the parents do all they can within their means—and more—she feels and lets them know that she does—that they have failed her.

Sam, her boy friend, fails to fill the bill because he is Sam, an able accountant and not the composite of Marlon Brando's virility, Einstein's intellect and John Kennedy's fame. Even though poor Sam doesn't fulfill her demands, she has agreed to marry him and is bent upon letting him know that he has in her a treasure really beyond his worth.

While the parents keep asking, "How did we let her down? What keeps going wrong?"—Sam is completely beaten. In his more aware moments, he can't understand why his fiancee doesn't hang on his every word, the way his mother does. He could say "To hell with this girl" and look for somebody else but, caught in Joan's trap, he tells himself he loves her and that he is willing to pay the price of his love. The price is that he marries her to live unhappily ever after. Joan, too, will always pay for what she has done to Sam.

Recipe three: How to make your family miserable without even trying, through the rebel-in-the-parlor routine.

Sixteen-year-old Don is a rebel at home. Out in the world he's meek enough, but at home he's a devil. He claims to know more than anyone else, to understand everything better and, in short, to be somehow superior in all things. His older brother Tom is just the same even though he's married. Nothing about Tom's wife, his friends, his job or his life is good enough for him in his Olympian mightiness.

These brothers are not social protestors. It is only life at home that provokes them to protest—not that they'd move out or make any other changes. They want everything to stay as it is because it is the futile protest that they enjoy. They take pleasure in the stormy weather, with no fair days, that they create, and take exquisite delight in seeing their families suffer and squirm. They are happy just so long as everyone is miserable and perhaps a little "sick".

Recipe four: How to drive your wife crazy by exploiting your own vices.

Ann has what her friends call a good husband. They live in an upper income suburb. For 20 years Ann and Bert were supposed to have been happy. To be sure, Bert has a few vices, but who doesn't?

The point is, however, that Bert exploits these vices. When, for instance, he attends a harmless party, he carries on as if he were a young boy on the make. The devoted swain of the girl he singles out (for the evening only), he mixes her drinks, dances only with her and succeeds at length in kissing her after he gets her to sit on his lap or backs her into a corner. Ann oozes hurt and pain and finally leaves without him to suffer less conspicuously at home. Some wives perhaps can laugh it off—but not Ann.

Burt, however, pleads innocence. He's done nothing, he insists, but have a good time. Ann must be out of her mind to give the whole silly little episode another thought. Is she such a prude that she doesn't know that parties are designed for flirting, for drinking, for having fun? Ann, sick of these scenes, cannot agree with Bert. "All right," he says, "would you rather have me drink? Another man would stay at the party until the last bottle was empty and then haunt the nearest bar to keep on drinking. Would you rather have me make that kind of spectacle of myself?" She sees no choice between the two vices. She just wishes that Bert would stop making a spectacle of himself.

The Berts of the world are subtle operators. Neither they nor the Anns they torment are ever quite able to tag the trouble that divides them. While revelling in their vices, the Berts present an innocent front to the world—and even to themselves. Their exploits and the front behind which they hide become weapons by which to drive their wives crazy.

Recipe five: How to create psychotics in your household.

The way members of the family interact with each other can cause serious psychoses. In his thorough study of madness shared by two or more (*Folie a deux*), Dr. Alexander Gralnick of High Point Hospital, New York, told the story of the Carrington family, of Anne, the domineering paranoid mother and wife, Cameron, the dependent husband, and their oppressed children, Edith and John.

Anne was a retiring, secretive girl, with no friends of either sex, while Cameron was a seaman who made friends easily. He met Anne in London when he was on leave. When Cameron was discharged from the navy, he returned to London to see Anne again. They married and moved to New York City. From the first Anne was ungracious to her neighbors, suspicious of them. She refused to associate with Cameron's friends and they faded out of the Carringtons' lives. Anne's attitude toward her husband changed. She grew domineering, correcting his every action. As long as Edith was the only child, Anne was an overprotective mother to her. When John was born, however, Anne concentrated solely on the boy.

Anne believed people were spying on her and she made Cameron,

whom she now regarded as her enemy, either be silent or speak in whispers. She allowed nobody, save the four of them, to enter the apartment and isolated her children from all others. Every step that her son made was literally under her scrutiny and he was forbidden to leave the house to play. Each morning she washed his feet as Mary Magdalene had washed the feet of Jesus. At night the boy shared her bed.

Edith, yanked out of school by her now obviously demented mother, sat at home, a prisoner, doing nothing, not even housework.

Cameron, caught in the family contagion, thought he was being hounded at work. Finding a new job in a factory, he contrasted the gaiety of the girls with whom he worked with the behavior of his wife.

At home Cameron began to hear the singing voices of the factory girls and voices that announced torments for his wife and death for himself. He finally went to see a doctor who sent him to a state mental hospital. It wasn't long until his wife and daughter followed him.

"The Carrington family," says Dr. Gralnick, "lived like a sick 'island' in society. Anne was the center and motivating force of their family culture. She established, enforced and judged its customs, laws, beliefs and behavior. She distorted and destroyed their human needs."

The weaker members of the family adopted the delusions of the dominant one.

The return of Halley's Comet

Last seen in 1910, the return visit of Halley's Comet should generate new theories, old superstitions and hopefully, more information.

by Robert S. Richardson

"WHEN will Halley's Comet be back?"

That is a question that people have been asking astronomers ever since this famous object last paid us a visit in 1910. The astronomers have not been of much help. "Oh, probably about 1987," they usually answer. "Might be as early as 1984 . . . or late as 1989. Nobody knows."

Now for the first time in nearly sixty years we *do* know. The answer is based upon some five thousand observations made at the comet's last returns in 1835 and 1910. The task of processing this mass of material was done by Joseph L. Brady and Edna Carpenter of the University of California's Lawrence Radiation Laboratory. We are going to use their results to try to answer some of the questions most often asked about Halley's Comet.

The question most often asked is the opening quote of this article. But the question as it stands is too vague. What astronomers want to know is, "When will Halley's Comet be at a certain particular place in its orbit?" The place always chosen is perihelion; perihelion being the point nearest the sun. So let us reword the question:

When will Halley's Comet pass the perihelion of its orbit?

Time of perihelion passage:

= 1986 February 5, 36775 UT

= 1986, Wednesday, Feb. 5, $03^h\ 49^m\ 34^s$, EST

That is, if you live in New York, Halley's Comet will pass the perihelion of its orbit in 1986, February 5, on Wednesday at 3 hours 49 minutes 34 seconds in the morning, Eastern Standard Time.

When will Halley's Comet be visible to the naked eye?

This depends upon its brightness and comets are notoriously unreliable in this respect. At the comet's last reurn it was first sighted without optical aid by Dr. Max Wolf of the Heidelberg Observatory, on February 11, 1910, which was 68 days before perihelion. (Dr. Wolf was also the first to recognize the comet's image on a photograph.) If the comet behaves the same next time, it would be visible without optical aid about November 25, 1985.

What will be the distance of Halley's Comet from the earth on that date?

It will be 53,940,000 miles from the earth and well placed for observation in the constellation of Aries.

What is the very earliest we may expect to see Halley's Comet?

At the comet's previous return or "apparition", its image was first detected on a photograph taken September 11, 1909, when distant 300,000,000 miles from the sun. The comet appeared as a mere smudge, quite different from our usual picture of a comet. Once having located the comet, astronomers backtracked and found it had been photographed unknowingly some 18 days earlier at the Helwan Observatory in Egypt. If everything were the same next time the comet would become observable about June 11, 1985.

But everything next time will *not* be the same. For in June of 1985 Halley's Comet will be behind the sun and hidden by its glare.

1-billion-mile sighting

Current photographic telescopes of special design, however, should enable us to detect the comet when still far beyond the reach of the best telescopes of the 1909 era. We will assume that the brightness of the comet at great distances follows a simple inverse square law. If this is the case we may be able to get a recognizable image when the comet is 10 astronomical units (au) from the sun and about the same distance from the earth. (1 au = 93,000,000 miles). This puts the comet at discovery beyond the orbit of Saturn at a distance of about one billion miles. With good luck we might pick it up as early as February, 1983. (But we emphasize again that comets are non-conformists and may fool us badly.)

What new observational technique may be used never applied to a comet before?

Instead of waiting for the comet to come to us, in 1986 we may go forth to meet the comet. We have sent probes and fly-by vehicles to Venus and Mars that have relayed back information about these bodies impossible to obtain with earth-based instruments. Telescopic observations of comets are so difficult

that knowledge of them increases very slowly. A successful comet-intercept experiment might yield more knowledge on comets in thirty minutes than could be acquired in the next thirty years by ordinary methods.

Making close contact with a comet, however, is not so easy as with a planet. No comet's path is known with nearly the degree of accuracy of a planet's. Nevertheless, a comet-intercept experiment is so tempting that it ought to be worth a try, even if the chances of success are not very good.

What is the distance of Halley's Comet from the sun when farthest away?

3,282,000,000 miles.

What is the orbital velocity of Halley's Comet when farthest from the sun?

2,040 miles per hour.

What is the distance of Halley's Comet from the sun when nearest at the perihelion of its orbit?

54,600,000 miles.

What is the orbital velocity of Halley's Comet at perihelion?

122,000 miles per hour.

Why is the orbital velocity so much higher at perihelion?

To explain the change in velocity would take a long while. But we can make it understandable at least by comparing the motion of the comet around the sun to the motion of a baseball in a high fly.

The ball soars upward losing velocity and is moving slowest when farthest from the ground. Then as it starts to fall it gains velocity and is moving fastest when it hits the ground. Similarly, Halley's Comet loses velocity and is moving slowest when farthest from the sun at the "top" of its curve. Then as it turns and starts "falling" it gains velocity and is moving fastest when nearest the sun.

"I remember when . . ."

Suppose you remember seeing Halley's Comet in 1910. What is the oldest (or youngest) you must be to see it a second time?

As the president of a now defunct organization called the Halley's Comet Club, this is a subject upon which I can speak with authority. I have received letters and talked with hundreds of people who claimed to have seen Halley's Comet in 1910. Some must have been mere babes at their mother's breast! And others could only have been aware of its presence while in some disembodied pre-natal existence.

We will assume that you could not have seen and remember seeing Halley's Comet in 1910 unless you were at least three years old. (As people grow older their memory for recent events tends to fail, although still retaining vivid recollections of their early childhood.) Suppose you saw Halley's comet on the date of your third birthday, which fell on June 1, 1910. About the earliest you can hope to see the comet next time would be December 1, 1985. Which would make your age 78.5 years. *And this is the very minimum!* Most second timers will be in their early eighties.

Some comets were so bright, they could be seen in daylight, only degrees from the sun.

What is the closest Halley's Comet will come to the earth?

Halley's Comet will be closest on April 8, 1986, when its distance will be 41,900,000 miles. It will be too far south to be seen over most of the United States, but favorably located for observation from the southern hemisphere in the constellation of Centaurus.

Will Halley's Comet come close to any of the inner planets?

The comet will be within 25,100,000 miles of Venus on Feb. 1, 1986, and next day within 26,000,000 miles of Mercury.

Much closer approaches have occurred in the past. Halley's Comet came within 14,000,000 miles of Venus on May 2, 1910, and within 14,300,000 miles of the earth on May 20, 1910.

Could Halley's Comet hit the earth?

No. So long as Halley's Comet follows its present orbit a collision is impossible.

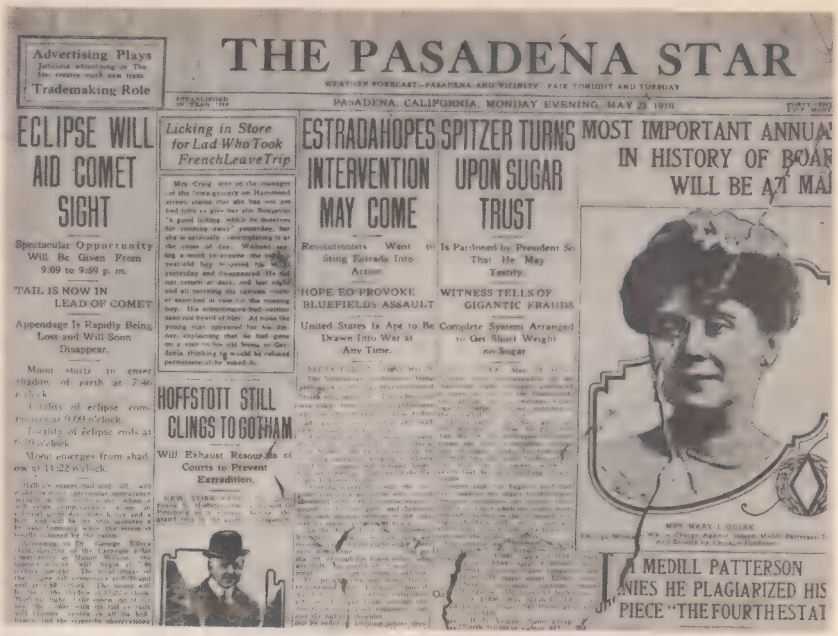
Could the earth encounter the tail of Halley's Comet?

Although a collision between the earth and cometary nucleus is impossible, the earth could encounter the comet's long tail. In fact, it actually happened on May 18, 1910. Many were terrified, believing they would be suffocated by poisonous fumes, and prepared for the worst. But nobody was reported to have suffered from the experience. The fact that the moon was totally eclipsed while Halley's Comet was still bright contributed to the panic.

Does the brightness of a comet depend more upon its distance from the sun or its distance from the earth?

The brightness of a comet—its real brightness—depends entirely upon its distance from the sun. Its apparent brightness as we see it depends not at all upon its distance from the earth, but upon its position relative to the sun. A faint naked-eye comet is easier to see against the dark midnight sky, than a much brighter comet against the light background of the dawn sky. Although we know of a few comets so bright they were visible in full daylight only a few degrees from the sun.

Comets when far from the sun are faint, fuzzy unstupendous looking objects, that bear no resemblance to the popular idea of a comet. They seldom begin to brighten until within the orbit of Mars, when the increasing intensity of the sun's rays starts stimulating them to emission. Often comets show irregular changes in brightness, brightening up perhaps a hundred times in a matter of hours or minutes. ("Almost instantaneously" according to some authorities!) The cause of these outbursts is wholly unknown. (Another good reason for a comet-intercept experiment.)


THE PASADENA STAR

WEATHER FORECAST—PASADENA AND VICINITY: FAIR TONIGHT AND TUESDAY

PASADENA, CALIFORNIA, MONDAY EVENING, MAY 29 1910

Advertising Plays Important Role in Trademaking

ECLIPSE WILL AID COMET SIGHT

Spectacular Opportunity Will Be Given From 9:09 to 9:59 p. m.

TAIL IS NOW IN LEAD OF COMET

Appendage Is Rapidly Being Lost and Will Soon Disappear.

Licking in Store for Lad Who Took French Leave Trip

ESTRADA HOPES INTERVENTION MAY COME

Revolutionists Want to Bring Estrada Into Action

HOPE TO PROVOKE BLUEFIELDS ASSAULT

United States Is Apt to Be Drawn Into War at Any Time.

SPITZER TURNS UPON SUGAR TRUST

Is Partisan to President So That He May Testify.

WITNESS TELLS OF GIGANTIC FRAUDS

Complete System Arranged to Get Short Weight on Sugar

MOST IMPORTANT ANNUA IN HISTORY OF BOAR WILL BE AT MA

MRS. MARY I. OLIVER

I MEDILL PATTERSON NIES HE PLAGIARIZED HIS PIECE "THE FOURTH ESTAT

HOFFSTOTT STILL CLINGS TO GOTHAM

Will Exhaust Resources of Courts to Prevent Extradition.

The last time Halley's Comet passed close enough to the earth to be seen it made headline news. When it comes back again in 1985-86 we may react with similar enthusiasm.

If we have not seen Halley's Comet since June, 1911, how can we be sure it is still out there? How do we know it will return in 1986?

We don't *know* that Halley's Comet will return in 1986 in the same way we know the sun will rise tomorrow morning. But I would be willing to wager a considerable sum of money payable to my heirs that it will return.

As a comet revolves around the sun it must be continually losing gas and dust to outer space. How long can the comet keep it up? How long until its supply is exhausted?

Cometary experts are sharply divided on this question. One group believes that on the average the short-period comets fade away after several hundred years. Another group maintains that they endure for thousands of revolutions. The question is hard to settle owing to lack of accurate observations. Comets apparently differ considerably among themselves in that some fade away faster than others.

Comet still gassed up

So far Halley's Comet shows no indication that it is running out of gas. Ancient records reveal it has been about as bright as usual at each return back to 240 B.C. The interval between returns averages 76.903 years, but has been as short as 74.5 years and as long as 79.3

years. The interval changes depending upon how the comet is disturbed by the planets, principally Jupiter and Saturn.

When will Halley's Comet begin to develop a tail?

First trace of a tail at the last apparition was detected 128 days before perihelion. This indicates a tail might be perceptible about October 1, 1985, when Halley's Comet is 151,000,000 miles from the sun, slightly outside the orbit of Mars.

From time immemorial a bright comet has been regarded as an omen of evil, foretelling war, death, and other disasters. Is there any foundation in such beliefs?

None whatever. They are merely the superstitious beliefs of ignorant people. (Or of supposedly educated people who ought to know better!)

People generally fear anything new and strange and attribute evil properties to it. Until late in the nineteenth century many people refused to eat that strange new fruit the tomato, believing it poisonous.

Our sins and troubles originate in ourselves, although we don't like to admit it. So we try to shift the blame to something outside ourselves like a comet.

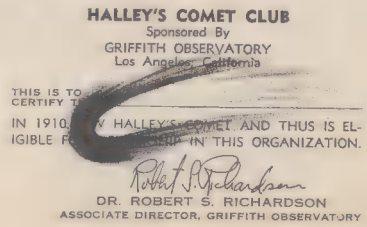
How did Halley's Comet get its name?

We don't actually know who "discovered" Halley's Comet.

Edmund Halley, the second Astronomer Royal of England, became convinced that the bright comet he had seen in 1682 was identical with bright comets that had appeared in 1607, 1531, 1456, and probably 1378 and 1301. That is, they were not six *different* comets but six different returns of the *same* comet. From his calculations he ventured to predict the comet would return late in 1758, but warned that the time was highly uncertain.

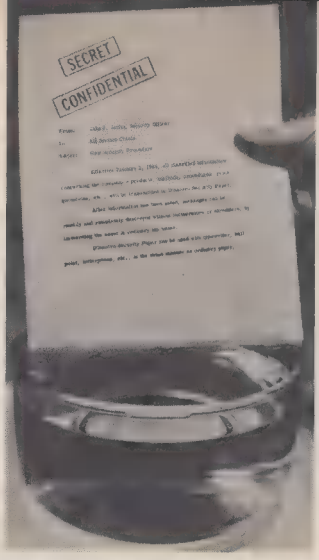
The announcement created a sensation. It was the first time anyone had ever dared to predict anything about such an erratic object as a comet. Halley was fairly safe when he made this prediction in 1705, as he was then 49, and would have to attain the age of 102 to see if his comet returned.

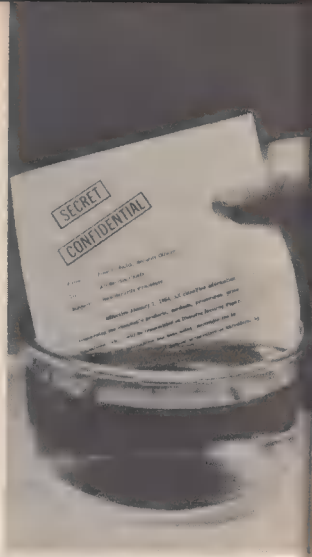
Halley kept busily at work almost to the day of his death in 1742. For awhile his prediction was almost forgotten. But as the year 1758 drew near interest began to revive, until practically everybody in Europe with a telescope was keeping watch on the place in the sky where the comet was supposed to appear. The prize fell to a farmer near Dresden, Germany, who sighted it on Christmas Day of 1758. Edmund Halley's bold prediction, originally derided, was now hailed with acclaim, and the comet forever afterward was known as Halley's Comet.

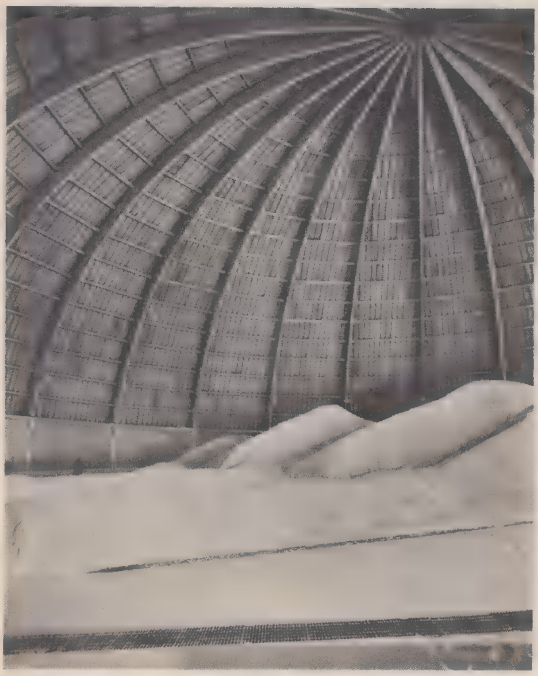


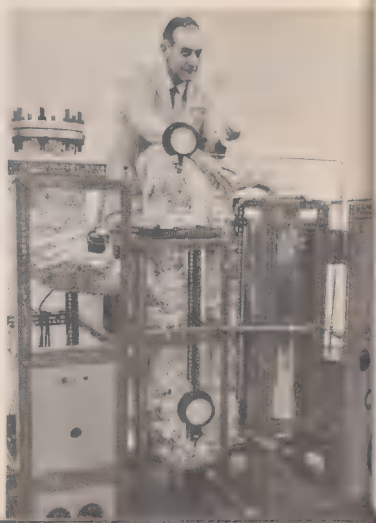
NEW FOR INDUSTRY

Water soluble paper used by secret agents, spies and diplomatic couriers to keep damaging information from falling into enemy hands now is available for industrial use in letter and legal size sheets and in rolls 51-inches wide. The product has the texture and appearance of ordinary paper but Dissolvo can be destroyed in a few seconds by immersing in water. It cannot be reconstituted. Gilbreth Co., 212 E. Courtland St., Philadelphia, Pa. 19120.

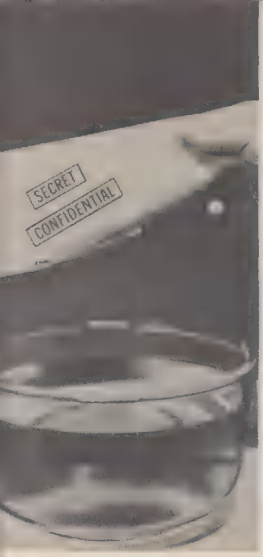








Storage dome at Washington's Port of Tacoma bulk unloading facilities is of laminated beam and wood construction with aluminum-sheathed exterior. A 25-cubic yard clamshell bucket that handles 14 tons of alumina at a bite fills the space at a rate of 750 tons an hour. The huge dome has a storage capacity of 50,000 tons.



Secondary electron spectroscopy is basically a new analytical technique for detection and identification of atoms on the surface of various materials. Developed at General Electric, the technique is an invaluable tool for surface chemists studying micro-effects on surfaces, for metallurgists analyzing contamination in metals and for engineers concerned with achieving a high degree of purity in making special products.

Above: Surface-supported deep diving is provided by Airco Mixmaker, product of Air Reduction Company. Four different gases or 100 percent oxygen may be mixed by operator.

Left: Technician completes installation of Atomic International's test equipment to study removal of sulfur dioxide from power plant flue gases. Study will aid air pollution control.

Right: Process developed by Vulcan Methods, Inc. pumps chemical through borings into water-saturated soil, solidifying soil and enabling construction work to go on.

Watch out for this

by Howard Earl

THE bite of a Brown Recluse or fiddler spider is more deadly than that of a Black Widow, and science is just beginning to realize that this spider is becoming increasingly common in the U.S.

Volume for volume, the Brown Recluse's venom is more potent than that of a rattlesnake. The toxic effects of the venom can cause gangrene. Many such cases have been seen by the University of Arkansas physicians who have made the Brown Recluse their specialty.

Known technically as *Loxesceles reclusus*, the spider is slightly smaller than the Black Widow. It has an oval body with four long legs on each side of the cephalothorax. The body varies in color from chocolate brown to fawn, is about half an inch long, a quarter of an inch wide and is covered with short hair invisible to the naked eye. A dark violin-shaped band on the head is a telltale mark enabling identity of the recluse from other brown spiders.

About 10 years ago investigators at the University of Missouri issued the first announcements on the potential dangers from the bite of a Brown Recluse, closely related to a

The Brown Recluse or fiddler spider is a growing menace in the United States. It hides in dark places and bites only when disturbed but injects a venom into its victim more lethal than rattlesnake venom or that of the Black Widow. Keep a wary eye for this spider. Dark violin-shaped band on head identifies a Recluse.

spider

species in South America known for almost a century to cause dangerous and occasionally gangrenous bites. After initial identification of the spider as a probable agent of necrotic bites—it is not known how long the recluse had existed in this country previous to its identification—physicians in Missouri and other states began to associate certain lesions with the Brown Recluse's bite. Since then, too, the spider has been seen in increasing numbers in Alabama, Arkansas, Colorado, Georgia, Illinois, Kansas, Louisiana, Mississippi, Missouri, North and South Carolina, Oklahoma and Texas.

The Brown Recluse hides in dark corners and crevices, beds, attics, closets, clothing, storerooms and barns. It bites only when disturbed or feels threatened, especially by a person moving in a bed or bedroll in which the recluse had hidden. Fortunately, the nocturnal habits and its retiring nature keep the little creature's bites at a fairly low incidence despite the large and rapidly increasing population of the recluse.

A growing worry to health authorities is the increasing mobility of the nation's population and vacationers traveling into areas where the Brown Recluse presently flourishes. Its tendency to hide in wadded-up newspapers, blankets and bedclothing carries the constant threat of transporting the gangrenous-venom injecting spider to states and areas where it has not been seen before.

Unfortunately, a person is not always aware that he has been the victim of a Brown Recluse's bite. There may or may not be a noticeable stinging sensation at the time of the bite or immediately following. But from two to eight hours later, the victim may suffer from nausea, severe abdominal cramps, joint pains and fever.

Investigators at the Veterans Administration Hospital in Little Rock, Arkansas, and at the University of Arkansas have developed a technique for "milking" the spiders of their venom by giving them mild electric shocks. Experiments with animals indicate the potent spider secretion brings death by causing hemorrhaging and collapse of blood vessels. The venom also is being studied for possible medical uses, especially isolated non-toxic fractions as a poison antidote.

Paul N. Brown, Ph.D., a research microbiologist at the VA Hospital in Little Rock, asserted recently, "Our data indicate a biological poison much more potent than known snake venoms." He added that so little is known about spider venom that it is impossible to estimate what might constitute a regularly fatal dose for an individual. It is known, however, that the female Brown Recluse ejects approximately twice as much venom as the male, whereas only the female Black Widow is venomous.

The wound, about three inches long, blisters and is surrounded by a hemorrhage. An ulcer may develop and become gangrenous. Treatment suggested by Dr. Calvin J. Dillaha of the University of Arkansas Medical Center is a heavy initial dosage of a cortisone-type hormone and repeated in reduced dosages every other day for ten days.

Treatment also may require excising the entire wound if gangrenous. In some cases it may be necessary to use skin graft to close the wound. Without such therapy, the hole may remain open indefinitely.

"Man! Talk about some action shots!"

Each month Dr. Isaac Asimov chooses one of the questions you send in to answer. He does not make the job easy on himself, for in past months he has written about such things as relativity, parity and the basic nature of light. Following Dr. Asimov's answer are the answers to some of your other questions written by regular members of the **Science Digest** staff.

Nothing—with a twist

What is meant by curved space?

On first encountering the notion that Einstein's theory of relativity speaks of "curved space", one has a right, perhaps, to feel puzzled. How can the vacuum of space be curved? How can you bend emptiness?

To see how that might be, let's begin by imagining someone in a spaceship carefully watching a nearby planet. The planet is covered completely by a deep ocean so that it is a sphere with a surface as smooth as a polished billiard ball. Let us suppose there is a ship sailing over the planetary ocean, along the equator, due east.

Now let's imagine something more. The planet is completely invisible to the observer. All he can see is the ship. As he studies its line of motion, he finds to his surprise that the ship is following a circular path. Eventually, it will return to its starting point and it will then have marked out a complete circle.

If the ship changes its course, the line bends and is no longer a simple circle. However, no matter how the ship changes its course, no matter how it veers and backtracks, its line of travel fits along the surface of a sphere.

Our observer might deduce from all this that the ship is being held to an invisible spherical surface by a force of gravity at the center of the sphere. Or he might decide that the ship is confined to a particular section of space and that section is curved in such a way as to force the ship to follow the course it does; a section of space is bent into a sphere. The choice, in other words, is between a force and a space-geometry.

You may think this is an imaginary situation, but it isn't really. Our planet moves in an ellipse about the sun, as though it were sailing

along some curved invisible surface. We explain it by supposing there is a force of gravity exerted between the sun and the earth that holds the earth in its orbit.

But suppose we consider space-geometry instead. We could define the geometry of space not by looking at space itself, which is invisible and can't be seen, but by noting the manner in which objects move in it. If space were "flat" then objects would move through it in straight lines; if space were "curved" then objects would follow curved paths.

An object of a given mass and speed moving at a great distance from any other mass does indeed move in almost a straight line. If it approaches another mass, its path becomes more and more curved. Mass, apparently, curves space; the greater the mass and the closer, the sharper the curvature.

It may seem far more convenient and natural to talk of gravitation as a force rather than as space-geometry—until light is considered. Light has no mass and should not be affected by gravitational force according to the older notions. If, however, light is travelling through curved space then its path should curve too. Allowing for light's speed, the amount by which its path would be curved when passing near the sun's huge mass can be calculated.

In 1919, this part of Einstein's theory (announced three years before) was tested during an eclipse of the sun. The positions of stars near the sun were compared with their recorded positions when the sun was not in that part of the heaven. Einstein's theory was upheld and it seemed more accurate to talk about gravity in terms of curved space rather than in terms of force.

It is only fair to say, though, that in 1967, certain delicate measurements of the sun's shape have brought Einstein's theory of gravitation into question. What will happen now and in the future, it is still a little too early to say.

—*Isaac Asimov*

Is there a difference between artificial and synthetic gems?

Yes, the term "artificial gem" usually refers to an imitation of a naturally-occurring gem such as the topaz, diamond or emerald. These imitations are frequently made of colored glass or plastic. They cost only a fraction as much as the stones they are copies of.

Synthetic stones, on the other hand, are identical—chemically, optically and physically—to the naturally-occurring gems. A little chemical alchemy can duplicate star sapphires, rubies, emeralds, even small diamonds.

Sapphires are made of pure aluminum oxide ($A1_20_3$). A fine powder of this substance is carried by oxygen gas in an apparatus that

looks like an oxy hydrogen torch with a flame directed into an insulating chamber. The powder fuses into droplets which begin to form a pear-shaped mass called a boule. This boule's size can be controlled by varying the gas flow, temperature and quantity of powder added to the furnace. The average boule is about one-half inch in diameter and one or two inches long when complete.

The sapphire recipe needs only small additions of various metal oxides to turn into other precious stones. Rubies, for instance, can be made by adding five to six percent chromium III oxide (Cr_2O_3). Blue sapphires are created by putting in titanium oxide.

To put stars in synthetic stones, the only extra ingredient is rutile (TiO_2). An excess of this substance plus a temperature in excess of 1000° C. will put stars in the stones. Synthetic stars are sharper than those in the natural gems.

Synthetic diamonds, too small for gem use, have been on the market for 10 years. General Electric Company first synthesized them under intense heat and pressure. Synthetic diamonds are often used in industry, where the diamond is valued for its hardness.

Synthetic stones can be distinguished from the naturally-occurring ones by their perfection. Under a microscope, synthetic gems contain no flaws. Natural stones always contain minute amounts of foreign materials and/or structural flaws.—*Jeanne Reinert*

Way out with Asimov

Is Anyone There? Isaac Asimov. Doubleday ($5.95)

For anyone who hankers for a trip through all the frontiers of science, with stopovers at curious wayside paradoxes and mysteries, there's no better tour director than Isaac Asimov. He's a top-notch interpreter, his English is plain and he doesn't try to duck controversial places.

This book (his 83rd—14 more are in process of being published) is made up largely of articles he's had published during the past decade. He calls it a collection of "speculative essays on the known and unknown."

Starting with the human mind ("more or less known"), he probes the schizophrenic personality and the nature of LSD (Its unguided use "is a kind of Russian roulette . . . an invitation to insanity for all.")

From there, he breaks man down into his component cells, genes, chromosomes, amino acids and atoms. Then, when you know all that, he proceeds, with documented evidence, to show how close we are to the construction of life itself, and the absolute control of procreation. While admitting the "anti-Utopian aspects of such a future," Dr. Asimov emphasizes the brighter side of its potential: "By removing the false extremes of good and evil from its image, sex might at last become the natural function it really is, and a potent source of neuroses may be removed forever from the human race."

If you still have doubts, consider what's in store for us if we go barging along unchecked in our production of people: We are currently doubling our population every 50 years. By 3500 A.D., every living person will have 2½ square feet to stand on, at this rate.

But suppose we could utilize all the carbon *in* the earth as well as on it, and move folks to other planets. "There are 135 trillion stars in our galaxy," Dr. Asimov points out, "and perhaps 100 trillion galaxies in the known universe." Assuming 10 planets for each sun, he figures that by 11,000 A.D., earthmen would be "stacked like cordwood over the entire surface of every one of a couple of trillion planets." His conclusion: The rate of population increase *must* decrease "either by increasing the death rate or decreasing the birth rate. Take your pick." Any arguments?

But that's not all. In his "More Or Less Unknown" section, Dr. Asimov gets down to cases—other worlds and other people. You'll learn that there may be as many as a million planets in our galaxy

that *can* bear intelligent life; that life can exist in atmospheres that would be fatal to us—and why. You'll find the concept of relativity explained in a nine-page chapter entitled "Time-Travel: One-Way"—without a single formula; you'll find a discription of the anatomy of a Martian, as he would have to be constructed in order to survive in his environment: (Eight feet tall, gawky, fragile skeleton, jointed backbone, flat feet, slow and sleepy). At least that's one way he might be if he existed at all, and you'll find out why. Asimov leaves no "danglers".

You'll also take a long trip into the future—based on things we know *now;* everything from living conditions here on earth (some not so enticing, such as solid megopolises of 40 million), to colonies on the moon and the things that are likely to be in store for our solar system, our galaxy and our universe.

Is anyone there? You bet. More "anyones" than you might care to dwell on, according to Dr. Asimov who, for all his "arrogant" modesty, is probably one of the most authentic prophets of our time—and certainly is one of the most lucid and interesting.—*RFD*

Time is Short and the Water Rises. John Walsh with Robert Gannon. E. P. Dutton & Company. ($6.95)

When, in 1964, the Aluminum Company of America opened the Afobaka-Dam in Surinam (once Dutch Guiana) in order to build a hydroelectric plant, 870 miles of tropical rain forest was doomed to become a tropical, stagnant swamp.

Amerindians, the only true natives of the region and the Bushnegro, descendants of escaped slaves were evacuated from their flooded villages to government-constructed "transmigration" camps. But left behind to fend for themselves were thousands of animals who could not swim 10 or 20 miles to safe land. Imprisoned on whatever land remained dry, the creatures would starve to death.

The title *Time is Short. . . .* describes exactly the crisis state the Brokopondo district of Surinam was in when John Walsh of the Massachusetts SPCA answered the distress call from the ISPA of Surinam. Water had already risen 20 feet and it wouldn't be too many months before the 150-foot *kan-kan* trees in the Bushnegro village centers and, naturally, everything around them, would be submerged.

Walsh's book is an occasionally slangy, but informative and well-paced story of Operation *Gwamba* (Saramaccan word for animal), the rescue mission, comprised of Walsh and a handful of Bushnegros recruited from the villages, that ultimately saved some 10,000 animals from a hungry and watery death. The operation is even more spectacular in view of the fact that these men worked with rude dugouts, Ketch-poles, nets and often ingenuity in place of the more streamlined equipment the red tape of customs held up for weeks at a

time. (Later, the effective tranquilizer rifle that "shoots" the animal to sleep became a staple of their weaponry.)

After overcoming the initial problem of finding the trapped animals, the next obstacle was enticing them from their hiding places (Alcoa allowed Walsh to use garbage from the project laborers' meals as bait) or going after them and capturing a frightened porcupine, lizard or whatever by force. He even had to dislodge a three-toed sloth from its temporary tree perch toe by toe. Then the rescuers had to transport the frequently squirming animals by dugout to high and dry land.

The writer doesn't embroider already courageous feats with false heroics. Nor does his indignation about the misery generated by the electric plant complex turn maudlin. Candidly and often ironically, Walsh brings out that salient fact: If the larger amounts of aluminum produced by this plant's increased output of electricity plumps up Surinam's income, it won't have been done without hardship on the people as well as the animals. The river, once used by the Bushnegro for drinking, fishing, sport, bathroom and sewage, will remain stagnant for a generation. Substituted for their immaculately kept bungalows scattered throughout a shady forest are tar-paper shacks lined up under a blistering sun.

A find for the reader of adventure stories, this one has some relevance to the people and the country in which it takes place.—*AS.*

Idea of the Month

Cable of life

General Electric's compact Cardiac Pacemaker, smaller than a pack of cigarettes (even the old regular size), is made to fit in the armpit area. Spirally wound electrodes are inserted through vein into heart.

Some 25,000 Americans carry about in their bodies cardiac pacers that stimulate their hearts to beat at the desired rate. The cables running from the electronic instrument into each heart must withstand flexing with every beat —100,000 times a day, or 30 million times a year.

The conductors must also withstand muscular stresses from the patient's movements, and corrosion. Two biomedical engineers who tackled the problem noted that the living body was chemically and biologically hostile to any invader, and that it was no wonder both the wires and insulation that were first used for the purpose showed early deterioration.

David C. Fisher and Hugh M. Forman of the General Electric X-ray department in Milwaukee sought a lead assembly that would be compatible with the body, and would have low electrical resistance, high flexibilty and long life.

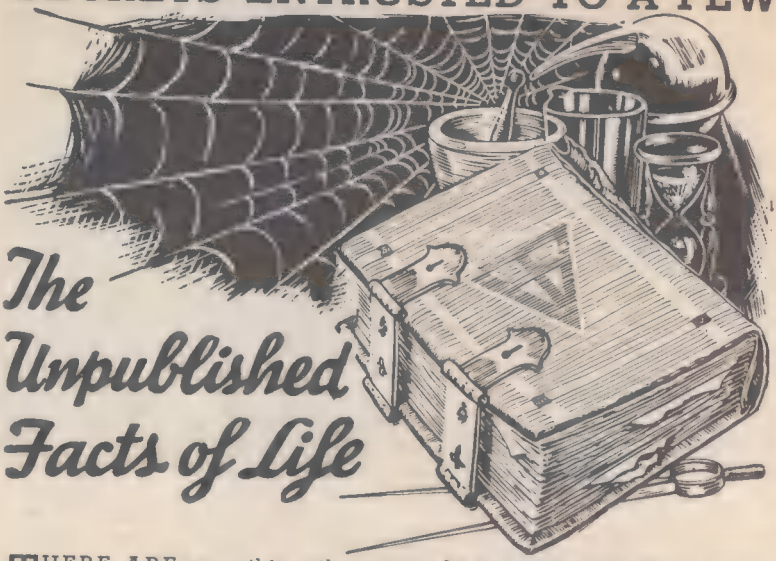
They were recently granted Patent 3,333,045 for twin cables that the company has found to be highly reliable. The conductors have remained implanted in known patients for from two and a half to three years without failure.

The cable is made of 294 strands of stainless steel and 49 strands of silver, coiled in a tight helix. Each of the two cables is encased in a silicone rubber tube that contains liquid silicone. The pair of tubes is surrounded by a silicone rubber sleeve.

When the implantation of the generators, or pacemakers, began in this country during the early 1960s, it meant a major operation. General Electric says its present four-ounce pacemaker, smaller than a cigarette package, can be installed in the armpit area under local anesthetic. Through a vein, the twin electrodes are inserted into the heart.

Pacemakers are operated by self-contained, long-life nickel cadmium or mercury batteries. A physician using a threshold analyzer can estimate the period that a battery has yet to run before it needs to be replaced.—*Stacy V. Jones.*

SECRETS ENTRUSTED TO A FEW



The Unpublished Facts of Life

THERE ARE some things that can not be generally told—*things you ought to know.* Great truths are dangerous to some—but factors for *personal power* and *accomplishment* in the hands of those who understand them. Behind the tales of the miracles and mysteries of the ancients, lie centuries of their secret probing into nature's laws—their amazing discoveries of *the hidden processes of man's mind,* and *the mastery of life's problems.* Once shrouded in mystery to avoid their destruction by mass fear and ignorance, these facts remain a useful heritage for the thousands of men and women who privately use them in their homes today.

THIS FREE BOOK

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U.P.I.

It's a noisy world

by John and Molly Daugherty

Noise contributes its share to urban pollution and adds to the problems of nervousness, ill tempers, and accidents. Mental health views the problem not only from the standpoint of how high the noise level is, but how frustrating it is. Even music when not in step with your mood can be a most intrusive and infuriating noise. What do you know about noise?

1. The modern definition of noise is generally
   a. A mixture of many unordered frequencies
   b. Unwanted sound, even not necessarily loud
   c. Sounds only excessively high on the decibel scale
2. The most widely used device against noise worn by airport ground crews is
   a. Cotton in the ears
   b. Ear plugs
   c. Ear muffs
3. The usual noisy urban environment doesn't bother a certain percentage of the population. The percentage not bothered by the noise is
   a. 25 percent
   b. 10 percent
   c. 75 percent

4. **Absorption of sound by acoustical ceiling tiles is most effective for**
   a. **Low pitched frequencies—around 125 cycles a second**
   b. **Frequencies in a range near 1,000 cycles a second**
   c. **High pitched frequencies—many thousands of cycles a second**

5. **You may not detect hearing loss until considerable damage occurs because noise usually first affects the**
   a. **Higher frequency ranges**
   b. **Range of frequencies needed for speech discrimination**
   c. **Lowest frequencies you can hear**

6. **Research measures noise in decibels. Noises cause actual pain at a level of**
   a. **90 decibels**
   b. **110 decibels**
   c. **140 decibels**

7. **Noise affects your body. Noise may**
   a. **Induce rapid heat loss from your body**
   b. **Constrict your tiny blood capillaries**
   c. **Constrict the pupils of your eyes**

8. **You can find a people who have little or no hearing loss with advancing age in**
   a. **Europe**
   b. **Africa**
   c. **North America**

9. **Permanent hearing loss from even short exposure to loud sounds may occur at**
   a. **90 decibels**
   b. **115 decibels**
   c. **150 decibels**

10. **If speech communication is an important part of your job, you can work most efficiently in an environment that is**
    a. **Quieter than a typist's**
    b. **Noisier than a typist's**
    c. **The same as a typist's**

Answers:

1—b Unwanted sound, even though not necessarily loud. This broad definition of noise means that what is noise to one person may not be noise to another.

2—c Ear muffs. Manufactured ear plugs are effective, too, but ear muffs can be maneuvered more readily. Cotton wads in the ear are practically useless around an airport with its high noise levels.

3—a Twenty-five percent say they aren't bothered by noise, according to surveys made in London and several American cities. They can live next to railroads, near airports, or on trucking routes, and still keep calm. Ten percent are annoyed by any sound, however faint, that they don't make themselves.

4—b Frequencies in a range near 1,000 cycles a second. An acoustical ceiling may absorb as much as three-fourths of the sound which strikes it. About two-thirds of the people interviewed in a national survey in major cities say they want *quiet* built into their next home. Even one quiet room in a home is a help.

5—a Higher frequency ranges. The inner ear analyzes high-frequency sounds at the front of the inner ear's chamber (or cochlea), but the lower frequencies travel farther along the path. There is a lot of wear in one small part of the inner ear by the high frequencies. Damage to the hair sensors occurs here first.

6—c 140 decibels. In decibels, a thunderclap may be 120; an airplane, 105; normal conversation, 60; and a whisper, 30. Decibels are not direct measures like distance and weight. The decibel scale is a logarithmic scale derived from a ratio of meas-

ured sound pressure to a fixed reference pressure.

7—b Constrict your tiny blood capillaries. If so, this constriction may have some connection with high blood pressure, heart trouble, and perhaps with the hearing loss itself due to malnutrition of the hearing mechanism. Some research shows this. We need to do more research to discover the damaging effects of noise.

8—b Africa. The Mabaans of the Sudan in Africa at the age of seventy-five hear as well as the average American at the age of twenty-five. The secret lies in living in an environment almost free from noises except those of nature. These people use no guns, drums, etc. European scientists subjecting the Mabaans to loud noise in research showed the effects of noise on the body.

9—c In an effort to control noise, New York State limits the noise permitted by trucks on the highway to 88 decibels. Using adequate mufflers and keeping trucks in repair serves to keep the noise level within the legal limit.

10—a Quieter than a typist's. But from the viewpoint of the typist, typing insulates her from auditory distraction and permits greater concentration. She doesn't mind the noise that she makes (about 60 decibels for an electric typewriter).

Score yourself:

9—10 right—You really whooped it up!
4— 8 right—No blast
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How to dig

I read the article on amateur archaeological work in your July issue (*Dig to Antiquity in Your Own Back Yard*) and I have some comments on it, from the point of view of an amateur who is working with professional and other amateur organizations. I am a member of the Novato Senior High Archaeology Club, and member in good standing of the Society for California Archaeology. We recognize the value of amateur work when done correctly, and we have excavated several sites in the northern Marin County area.

From personal experience, we would recommend the following steps to anyone who is interested in doing his own archaeological research:

1. Check with your nearest natural history museum about antiquities laws in your area! In Marin County, California, for instance, it is a criminal offense punishable by up to six months in jail and $500 fine for an amateur to excavate or disturb any archaeological site without first having received clearance in writing from a recognized agency.

2. Read whatever you can find on the history and artifacts of your local Indians. Then try the local museum or university again for some pointers on the way to excavate sites. In most instances, if you show some knowledge and interest, the professionals will be very helpful.

3. Try to find others like yourself who are interested in digging and form a club. In this way the work can be spread out over many people. Set up a club organization and treasury—you will need about $25-$35 to get set up so you can work efficiently.

4. When you find a good site and begin digging, set up some regular system of base lines to dig pits and trenches with. Don't just dig large, round holes at random!

5. After you find an artifact, write up or draw the place where you found it on a list or diagram—then store the papers in a safe place. If you can number the artifacts and keep track of where you got each one, you are following the best method.

6. Finally, when you have exhausted any one site or believe that you have a good representative sample of the site materials, write up what you found in a report or just turn over a copy of your lists and diagrams to the nearest museum. They will undoubtedly appreciate them if you had checked with them earlier and if you've done a good job of digging and recording. Also, you will have made a genuine contribution to the science of archaeology while having fun yourself.

Of course, I have left out many things in this short summary, but the key is for the amateur to check with the local professional archaeologists or anthropologists (either those at a museum or the local college will be able to help and advise). The professional is the only safe source of information. In the year our club has existed we have found that fact out many times.

TERRENCE JAY O'NEIL
Novato, Calif.

All fake

I was reading your fascinating article "How Science Uncovers Art Fakes" (Aug. '67) when I took a second look at the picture on page 10. The picture shows a man trying to decide which painting of a row of Mona Lisa's is the real one. I can help him out. All the paintings in the photo had her (Mona Lisa) turned to her left. The real one has Mona Lisa turned to her right. Someone "flopped" the negative of your picture.

MICHAEL FEATHERS
Hattiesburg, Miss.

Contrasting experience

This letter is written in response to the article, "Test Tube Children" (July, '67). Without a systematic comparison of the outcome, the author paints a sordid picture.

My own experience contrasts sharply with this picture. I recall being invited to the home of an architect in Hawaii. Only one child was present in a group of friends and relatives, a beautiful slender girl of about ten who moved with the grace and assurance of a princess. In the course of the evening her parents told me that she was theirs by artificial insemination. I came away with the feeling that the family was grateful to science and to the donor for making this situation possible.

The child related well to all of us and was able to occupy herself interestingly while the grown-ups went on with the party.

What I'm trying to say is we need more data before using photos of somber-eyed children to illustrate such articles.

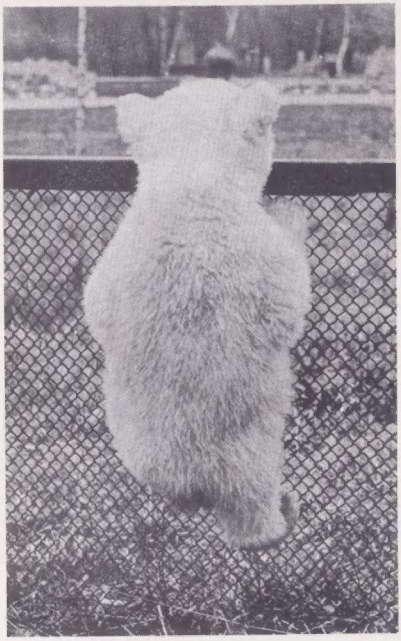
AUGUSTA M. SCHREIBER
Denver, Colorado

Comical–while young

FULL grown, a polar bear can be over 1,400 pounds of white-furred ferocity. But they make comical cubs, and rank among the top zoo attractions. Fortunately for the zoo going public, the polar bear breeds easily in captivity, and young bears often are available to delight the crowd.

Above, Alf of London's Whipsnade Zoo takes a tumble during his first public outing. His sister Marjorie, and mother Sonya seem unconcerned.

Right, young polar bear in the zoo in Lodz Poland climbs the fence to get a better look at the world.



In this issue . . .

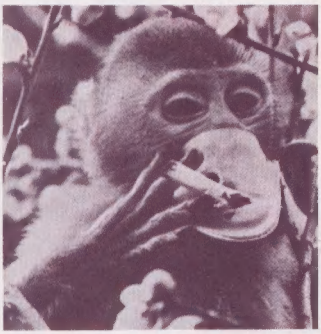
By taking a "heat picture" of urethane foam insulated tank car, a chemical company was able to locate potential trouble spots. Thermography makes use of infrared light, an increasingly valuable tool for science, and industry. A special report begins on page 40.

It all started with a few pairs of rabbits. The Australian rancher didn't know what he was letting himself or his country in for. It took years, to bring the rabbit population back down to manageable size, now it is beginning to go up again. Page 18.

Do you sometime feel as if the noises of the city will drive you nuts. They can, you know. And they can do a lot of other really awful things to you—or you can remain quite untouched—it all depends on what kind of person you are. Page 89.

We all know Halley's comet is due to return—but when? Science Digest presents the first accurate and complete timetable for the next visit of this most celebrated of the celestial wanderers. Page 70.

Everyone feels lonely some of the time, but there are those among us who feel lonely all the time. A noted psychologist has worked out a formula to overcome this feeling. Page 33.



One major problem in studying lung cancer in the lab, is that animals won't smoke. Now Russian scientists say that by using a special face mask they have induced monkeys to take a puff. See Science Month, page 21.

Her name is the brown recluse or fiddler spider, because of the fiddle shaped mark on her back. But if you ever get close enough to see that mark—you're in real trouble. Find out why in the story on page 78.